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THE UNIVERSITY OF ALBERTA

THE INTER-RELATIONSHIP BETWEEN PERMISSIBLE SEQUENCES OF ENGLISH ORTHOGRAPHY, WORD IDENTIFICATION, AND SPELLING

by

© JANET MacINTOSH

A THESIS

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled "The Inter-relationship Between Permissible Sequences of English Orthography, Word Identification, and Spelling" submitted by Janet MacIntosh in partial fulfilment of the requirements for the degree of Master of Education in Reading.

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ABSTRACT

This study examined children's knowledge of English orthography, word identification, and spelling to determine the relationship existing between these three areas. The pattern of development in differentiating pseudo-words of varying approximation to English was also examined.

The experimental group used in this study consisted of 90 students from grades one, two, and three from a school selected by the Edmonton Public School Board. The subjects were administered tests measuring achievement in word identification, spelling, identification of permissible sequences, and construction of permissible sequences. The teachers of the sample completed a questionnaire and were interviewed individually to determine the language arts approach used and the emphasis placed on reading.

Statistical analyses, by means of Pearson Product Moment correlation and one-way analysis of variance, were applied to the data. T-tests were carried out to determine the difference between the means of independent samples. Scores were grouped for boys and girls as no significant difference was found between the sexes in any of the four tests.

The analyses revealed that the relationship between the four tests was significant at the .01 level. A statistically significant increase in scores was found to occur on all measures

between grades one and two, and between grades one and three. Only spelling scores showed a significant increase between grades two and three.

A breakdown of these scores indicated the number of high-frequency and low-frequency responses chosen in each grade. A preference for identifying and constructing high-frequency sequences occurred at all grade levels. Save one disagreement, the results indicated a significant increase from grade one to grade two, and a non-significant increase from grade two to grade three in the number of high- and low-frequency responses chosen.

The subjects of all grades identified fewer high-frequency responses and more low-frequency responses with ascending grade. In constructing sequences, the number of low-frequency responses increased from grades one to two but did not increase from grades two to three. Conversely the number of high-frequency responses constructed decreased from grades one to two but did not decrease from grades two to three.

Top achievers and bottom achievers were selected for each grade and for the total group on the basis of scores on the four tests. Top achievers and bottom achievers showed no significant difference in their selection of high- or low-frequency responses. This indicated that scholastic achievement was not the basis on which children's preference for high- or low-frequency sequences rests.

The theory that students are able to differentiate permissible from non-permissible sequences of letters was supported by the research of this study.

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TABLE OF CONTENTS

Chapter Page

I. THE PROBLEM. 1
- BACKGROUND TO THE PROBLEM 1
- PURPOSE. 4
- DEFINITION OF TERMS 5
- HYPOTHESES 7
- RESEARCH DESIGN 8
  - Sample 8
  - Procedure 9
- LIMITATIONS 9
- SIGNIFICANCE 10
- OVERVIEW OF THE STUDY 11

II. REVIEW OF SELECTED LITERATURE 12
- TRADITIONAL VIEWS ON WORD IDENTIFICATION . . 13
- THE STRUCTURE OF ENGLISH ORTHOGRAPHY 15
  - Graphotactics 16
  - Grapheme - Phoneme Correspondence 16
- THE SEARCH FOR HIGHER ORDER UNITS 19
- THE ROLE OF GRAPHEME - PHONEME CORRESPONDENCES IN THE PERCEPTION OF WORDS 20
- THE PRONOUNCEABILITY - FREQUENCY DEBATE. . . 25

Chapter Page

THE ROLE OF SPELLING PATTERNS IN THE PERCEPTION OF WORDS. 29

ACQUISITION OF AWARENESS OF SPELLING PATTERNS 32

THE RELATIONSHIP BETWEEN PERMISSIBLE SEQUENCE AWARENESS AND READING ACHIVEEMENT. 34

THE RELATIONSHIP BETWEEN AWARENESS OF PERMISSIBLE SEQUENCES AND SPELLING ACHIEVEMENT. 36

THE RELATIONSHIP BETWEEN READING AND SPELLING 38

SEX DIFFERENCES IN READING AND SPELLING . . 39

SUMMARY. 42

III. THE RESEARCH DESIGN 43

THE SAMPLE 43

Socioeconomic Factor 44

Language Factor. 45

Selection of the Sample 46

TEST INSTRUMENTS 46

Standardized Tests 47

Slosson Oral Reading Test 47

Graded Word Spelling Test B 47

Informal Tests 48

Test of Orthographic Structure 48

Test of Letter Familiarity 49

Chapter Page

PILOT STUDY. 50

TEST PROCEDURE 54

Group Tests 54

Individual Test 55

Instructions 55

Graded Word Spelling Test B 56

Test of Orthographic Structure 56

Test of Letter Familiarity 57

Slosson Oral Reading Test. 58

QUESTIONNAIRE AND INTERVIEW 59

Questionnaire 59

Interview 59

ANALYSIS OF DATA 60

Pearson Product Moment Correlations (DEST 02). 60

One Way Analysis of Variance (ANOV 15) . . 61

Scheffé Multiple Comparison of Means (ANOV 15) 62

SUMMARY 62

IV. THE FINDINGS OF THE STUDY. 64

THE FINDINGS WITH RESPECT TO THE HYPOTHESES. 64

Hypothesis One 64

Hypothesis Two 65

Hypothesis Three 68

Chapter Page

Student performance in word identification. 68

Student performance in spelling 71

Student performance in identification of PS 73

Student performance in construction of PS 76

Hypothesis Four 78

PS identification 79

PS construction 82

Hypothesis Five 85

SUMMARY OF THE RESULTS 91

ADDITIONAL FINDINGS 93

Scoring Methods 93

V. SUMMARY, MAIN FINDINGS AND CONCLUSIONS, IMPLICATIONS AND SUGGESTIONS FOR FURTHER RESEARCH 98

SUMMARY 98

MAIN FINDINGS AND CONCLUSIONS 99

Hypothesis One 99

Hypothesis Two 100

Hypothesis Three 102

Hypothesis Four 105

Hypothesis Five 107

Additional Findings 109

Scoring Methods 109

Chapter Page

IMPLICATIONS 110

SUGGESTIONS FOR FURTHER RESEARCH 112

REFERENCES. 116

APPENDICES 124

LIST OF TABLES

Table | Page

I. Distribution of Boys and Girls in the Sample. . 44

II. Sequential Ordering of Group Tests. 54

III. Temporal Ordering of Group Tests. 55

IV. Correlations Between Sex and Test Scores Across Grade Levels 65

V. Correlations Between the Test Scores Across Grade Levels 66

VI. Student Performance in Word Identification . . . 70

VII. Analysis of Variance in Word Identification . . 70

VIII. The Scheffé Comparison of Means on Word Identification Scores Across Grades 71

IX. Student performance in Spelling 72

X. Analysis of Variance in Spelling Scores 72

XI. The Scheffé Comparison of Means on Spelling Scores Across Grades 73

XII. Student Performance in Identification of Permissible Sequences. 74

XIII. Analysis of Variance in Identification of Permissible Sequences. 75

XIV. The Scheffé Comparison of Means on Identification of Permissible Sequence Scores Across Grades 75

XV. Student Performance in Construction of Permissible Sequences 76

XVI. Analysis of Variance in Construction of Permissible Sequence Scores 78

Table Page

XVII. The Scheffé Comparison of Means on Construction of Permissible Sequences Across Grades 78

XVIII. Student Performance in Identification of Permissible Sequences, Types of Responses . . . 80

XIX. Analysis of Variance in Identification of Permissible Sequences, Types of Responses . . 81

XX. The Scheffé Comparison of Means in Identification of Permissible Sequences, Types of Responses 82

XXI. Student Performance in Construction of Permissible Sequences, Types of Responses . . . 83

XXII. Analysis of Variance in Construction of Permissible Sequences, Types of Responses . . . 84

XXIII. The Scheffé Comparison of Means in Construction of Permissible Sequences, Types of Responses 85

XXIV. Frequency Preference of Top and Bottom Achievers Based on Word Identification 88

XXV. Frequency Preference of Top and Bottom Achievers Based on Spelling 89

XXVI. Frequency Perference of Top and Bottom Achievers Based on Identification of Permissible Sequences 90

XXVII. Frequency Preference of Top and Bottom Achievers Based on Construction of Permissible Sequences 91

XXVIII. Correlations of the Four Tests Using Two Scoring Methods 95

Table Page

XXIX. Comparison of Means of the Tests of Identification and Construction of Permissible Sequences Using Two Methods of Scoring 96

XXX. Comparison of Means from Heck and from this study in Tests of Permissible Sequence Identification and Construction. 97

LIST OF FIGURES

Figure Page

1 Test Correlations 61

2 Cross-relationships Between the Four Tests. . . 68

CHAPTER I

THE PROBLEM

I. BACKGROUND TO THE PROBLEM

Reading and writing are acts of transmitting meaning. Creating access to meaning through writing, and gaining access to meaning through reading depend mainly on prior mastery of the language structure. "It is the school's task to help the pupil to develop proficiency in encoding and decoding these graphic signals of our language (Hanna & Hodges, 1963, p. 3)." The task is complicated, however, by researchers' and educators' incomplete understanding of these processes. "Learning to read well and to spell efficiently are complementary activities--success or difficulty in both go hand in hand--but the relationship is far from absolute (Fay, p. 6, 1969)." This indicates a need for further research into the relationship of sound and symbol in the English language, and into the internal structure of English orthography, as well as into how both these factors are perceived and learned by children.

Some researchers, in endeavoring to understand how words are perceived, have found that certain factors are not applicable. Marchbanks and Levin (1965) demonstrated that shape was the cue least used by children learning to read. Cattell (1947) demonstrated that skilled readers do not engage in letter-by-letter processing. It was found that neither pronounceability (Gibson, 1970) nor meaningfulness

(Postman & Rosenzweig, 1963) is a significant variable in word identification.

How then are words perceived? Samuels (1970), in examining modes of word recognition, stated: "it is now known that naive readers tend to select a detail rather than the entire word" and "while it is known that the adult can perceive several letters together as a unit in word recognition, no one knows at the present time when beginning readers perceive these higher order units (p. 33)." Linguists such as Venezky (1967) have strongly recommended that it is necessary to consider letter patterns beyond the simple sound-letter correspondence level if a more consistent relationship between oral and written language forms is to be realized. A series of experiments by Gibson and her associates (1962, 1963) indicated that children, in learning to read, extract English spelling patterns having an invariant relationship with a phonemic pattern (grapheme-phoneme correspondences). It appears that these correspondences function as units of visual perception in the identification of words. Anisfeld (1964) criticized Gibson's interpretation of pronounceability as being the variable determining ease of recognition of grapheme-phoneme correspondences. He suggested that summed digram and trigram frequencies may be a more important factor. The role that these frequencies play in the identification of words has not been clarified. Gibson (1970) revised her interpretation of earlier research, however, and suggested that knowledge of orthographic structure may be of greater importance than pronounceability in word identification. Rosinski and Wheeler

(1972) supported this interpretation and concluded that children learn to extract the orthographic structure of English words between the beginning of the first and third grade.

Research seems to point to an awareness of the sequential probabilities of orthography as being a crucial factor in word identification. Printed English is not a random sequence of letters. Carson (1961) stated that redundancy exists in the sequence of symbols which compose the language. Smith (1969) suggested that words are identified from information that reduces the uncertainty of the letter sequence without determining the letters completely. The letters preceding and following a specific letter aid in determining what that letter is. He concluded that awareness of the sequential possibilities in English orthography permits the identification of letters in words more easily than letters in isolation. Hence ability to make use of sequentially dependent letters, forming clusters, should facilitate word identification.

Another aspect of written communication, spelling, was examined in the light of sequential probabilities of letters by Wallach (1963). He predicted that it was sensitivity to the transitional probabilities governing the arrangement of letters that underlies good spelling. Once again this indicates that letters are perceived in terms of their environments, i.e., not individually but as a cluster. Furthermore, it indicates a possible relationship between familiarity with these letter clusters, or permissible sequences, and spelling ability.

Heck (1972) tested achieving and non-achieving readers' awareness of permissible sequences of letters using word-like structures of three types, having different degrees of approximation to English. His low correlation between awareness of permissible sequences and reading achievement may have been due to the broad nature of reading comprehension, and to his method of scoring.

Previous investigation indicated the possibility of a relationship between identifying and constructing words, and between identifying and constructing permissible sequences. Newton (1960) found a significant positive correlation between achievement in spelling and word identification (i.e., between the encoding and decoding skills of children). Heck's (1972) study assumed, but did not statistically correlate, a relationship between identifying and constructing permissible sequences. Abilities to decode and encode permissible sequences, then, may be related to abilities to decode and encode morphemes.

II. PURPOSE

The purpose of this study was to examine children's knowledge of permissible sequences, English orthography, word identification, and spelling to determine the relationship existing between these three abilities. Ability to identify and to construct permissible sequences of varying frequencies was also examined to determine when, in children's development, this awareness appears to take place.

III. DEFINITION OF TERMS

Orthography

Orthography is the art of writing words with the proper letters, according to standard usage (The Random House Dictionary of the English Language).

Word Identification

Word identification in this study refers to the act of reading words with the correct pronunciation and stress.

Grapheme

The grapheme is the unit of writing which represents some portion of the sounds of language.

Phoneme

The phoneme is the smallest meaningful unit of sound in language (Hanna, Hodges, & Hanna, 1971).

Grapheme-phoneme Correspondences

Grapheme-phoneme correspondences refer to the inter-relationship of the oral and written system of a language such that a letter or grapheme group in a particular graphic environment results in the utterance of a specific sequence of phonemes. In this study, only invariant grapheme-phoneme correspondences are considered. These refer to a letter or cluster of letters in a given graphic position within the written word, which bears an invariant relationship with a phonemic pattern (Gibson et al., 1962).

Sequential Probability (of letters)

Sequential probability is the degree to which the environment of each letter in a word determines the likelihood of the occurrence of each other letter (letter redundancy).

Permissible Sequence (PS)

A PS is a group of consecutive letters of varying degrees of internal dependency ordered so as to follow the rules of orthographic structure.

Non-permissible Sequence (NPS)

An NPS is a group of consecutive letters that could not be generated according to the rules of orthographic structure.

High-frequency Sequence

A high-frequency sequence is a PS whose summed digram and trigram frequency count (according to the tables of Mayzner and Tresselt, 1965) is high in relation to the other PS found in the same test item.

Low-frequency Sequence

A low-frequency sequence is a PS whose summed digram and trigram frequency count (according to the tables of Mayzner and Tresselt, 1965) is low in relation to the other PS found in the same test item.

Pseudo-word

A pseudo-word is a word-like structure comprised of a PS or an NPS. All words on the Test of Orthographic Structure and on the Test of Letter Familiarity were considered pseudo-words, although one-third of these were real words occurring less than five times per million words.

Top Achievers

Top achievers in this study were those subjects who scored in the upper third of the class or in the total group in one of:

(a) word identification achievement,

(b) spelling achievement,

(c) identification of PS, and

(d) construction of PS.

Bottom Achievers

Bottom achievers in this study were those subjects who scored in the lower third of the class or in the total group in one of:

(a) word identification achievement,

(b) spelling achievement,

(c) identification of PS, and

(d) construction of PS.

Abbreviations

The following abbreviations were used throughout the study:

PS = Permissible sequence

NPS = Non-permissible sequence

IV. HYPOTHESES

The following hypotheses were formulated for testing in this study:

1. There is no significant correlation in each of grades one, two, and three and in the total group, between sex and achievement in word identification, spelling, PS identification, and PS construction.

2. There is no significant correlation on test scores in each of grades one, two, and three, and in the total group between:

    (a) word identification and spelling,

    (b) word identification and PS identification,

    (c) spelling and PS construction,

    (d) PS identification and PS construction.

3. There is no significant difference between achievement in grade one, grade two, and grade three in word identification, spelling, PS identification, and PS construction.

4. There is no significant difference between grade one, grade two, and grade three in their scores of high-frequency and low-frequency sequences.

5. There is no significant difference between scores of top achievers and scores of bottom achievers of each grade and of the total group in their selection of high-frequency or low-frequency sequences.

V. RESEARCH DESIGN

Sample

The sample used in this study was selected from a school designated by the Edmonton Public School Board, and consisted of 30 students in each of grades one, two, and three. These children came from middle class homes and had a wide range of school achievement.

Procedure

1. All children in the sample were tested on four instruments:
   - (a) the Slosson Oral Reading Test
   - (b) the Graded Word Spelling Test B (Schonell)
   - (c) the Test of Orthographic Structure (Heck, 1972)
   - (d) the Test of Letter Familiarity (Heck)

All tests were hand-scored by the investigator.

2. After testing was completed, the nine classroom teachers of the students involved in the study were interviewed individually and completed a questionnaire, to determine the reading and language approach used and the emphasis placed on reading.

3. The hypotheses were tested by determining the significance of the Pearson Product Moment correlation coefficients, and by a one-way analysis of variance. A probability of .05 was selected to determine significance. The data were analyzed at the Department of Educational Research Services, University of Alberta, and interpreted by the researcher.

All testing was conducted by the researcher in a two-week period in April, 1973.

VI. LIMITATIONS

In interpreting the data of this study, the following limitations should be borne in mind:

1. Having the children leave the room individually as they completed the Graded Word Spelling Test, may have added an anxiety factor to those remaining in the classroom.

2. Two of the tests used in the study were originally designed (Heck, 1972) for individual administration but were used as group tests in the present study. Different results might have been obtained had the tests been individually administered.

3. Test items on Heck's tests were constructed on the basis of the reported frequency of digrams and trigrams in a twenty thousand word list. A number of these words may have contained letter sequences to which the children had not been exposed. Similarly, although the twenty thousand words are representative of all English words, the frequency counts of the letter groups are relative to these words.

VII. SIGNIFICANCE

If knowledge of PS is related to abilities to decode and encode morphemes, attention may be drawn to the importance of PS in children's acquisition of reading and writing skills. Questions may then arise as to whether this awareness aids word identification and spelling, whether it is the result of increasing skill in these two areas, or whether the development of these areas is concomitant. Further information with regard to the time in children's development at which they extract orthographic structure, may lead to a better understanding of the development of reading and spelling skills.

VIII. OVERVIEW OF THE STUDY

In Chapter II the writer will review the available literature which is considered pertinent to the present study. In doing so, it is hoped to construct a framework in which to consider the present research.

The experimental design of the study will be outlined in Chapter III. Information on the pilot study, the sample, and on the administration of the tests, will be presented.

The results of the study will be analyzed and explained in Chapter IV.

The final chapter will present the summary, conclusions, implications, and suggestions for further research.

CHAPTER II

REVIEW OF SELECTED LITERATURE

> Man's major code is natural language, which in its oral form is learned at home. Encipherments of natural language, such as reading and writing, appear to be the next most important learning tools, basically because they provide those who master them with a secondary longterm memory system which is collective as well as individual (Reimer & Illich, 1971, p. 8).

Instruction of the reading and writing processes is usually delegated to the school system. They are often thought of, by grammarians and spelling reformers, as mirror images of each other--reading being the receptive phase and writing being the transmitting phase. In the one instance, the reader is required to decode visual information, while in the other, the writer must encode phonological information into the appropriate visual symbols. "But there are radical differences between the skills and knowledge employed in reading and those employed in writing; just as there are considerable differences in learning to read and in learning to write (Smith, 1973, p. 117)."

This study will investigate research on these two processes. Although more emphasis will be placed on the decoding process of written communication, specifically word identification, one aspect of the encoding process will also be examined, that of spelling.

English orthographic structure, which is utilized in both identification and spelling, has been the subject of debate for many years. Research into its regularity, or lack of, will be examined, as well as research which is concerned with the relationship between sound and symbol in the English language. Children's acquisition of these linguistic patterns in learning to read will also be examined.

I. TRADITIONAL VIEWS ON WORD IDENTIFICATION

Aukerman (1971) has noted over 100 different approaches to teaching reading. The wide variety of methods used in schools today indicates that educators seem to be unsure of what the actual process of decoding written symbols into words entails. This confusion is evident in research dating back into the nineteenth century and the controversy over word perception still continues.

Proponents of the "phonics" approach contend that since written English is alphabetic, the reader simply pairs each letter with a corresponding phoneme and decodes the letters one at a time. The alphabetic principle requires that each phoneme in a language shall have its own unique graphic counterpart (Hanna, Hodges & Hanna, 1971). However, single letters have no invariant acoustic match in our language. This is evidenced by the fact that the English language contains over forty phonemes and only twenty-six letters. Therefore a one-to one matching method of identifying words is not always possible. The one-to-one matching of letters to sound has also been refuted by research on the basis of the perception of speech. Liberman, Cooper, Shakweiler, and Studdert-Kennedy (1967) report that single letter sounds are not processed individually by the auditory system. Rather, it appears that speech sounds are processed in syllabic segments.

Thus a correspondence of a single letter to a discrete phoneme would be virtually impossible.

The letter-by-letter hypothesis of word perception was refuted as early as 1885 by Cattell. His classic study (as quoted by Smith, 1973) showed that from a single tachistoscopic exposure a skilled reader can identify: (a) four or five unconnected letters; (b) two unconnected words; or (c) four or five words in a meaningful sequence (a phrase or short sentence). If words can be identified almost as fast as letters, then letter-by-letter processing seems inefficient. Pierce and Karlin (1957), Neisser and Beller (1965), and Neisser and Stoper (1965) also show evidence that word identification by fluent readers is too fast for letter-by-letter analysis.

Cattell's findings and those of Erdman and Dodge in 1898 (as quoted in Smith, 1973) show that words can be identified in conditions under which none of their component letters are individually discriminable. Many researchers concluded that the unit of perception was the whole word. This finding was supported by Gestalt psychology. Reading, some educators concluded, should be taught by the whole-word or configuration method.

This method also is difficult to support as it implies that a reader can store in his memory approximately 50,000 different shapes, and even this cannot account for differentiation between certain words having the same shape (e.g., hook, book). In 1965, Marchbanks and Levin demonstrated that shape was the cue least used by children learning to read, and that the beginning letter was the most salient clue.

One of the most important criteria of the effectiveness of a teaching method is the amount of transfer which a method yields. Bishop (1964) tested the transfer value of training with individual letters as compared to whole words. Although her subjects were adults learning Arabic, her finding that letter training is superior to word training in transfer to reading new words, was supported by Jeffrey and Samuels (1967) using kindergarten children and monosyllabic English words. Both pieces of research showed that knowledge of the relationship between letters within the word is necessary for transfer.

The answer to this argument of how words are perceived lies in discovering the unit-forming principles in reading activity (Gibson, 1970). The basis for forming units may lie within the structure of the orthography itself.

II. THE STRUCTURE OF ENGLISH ORTHOGRAPHY

"Learning to read is to a great extent learning to relate orthographic forms to already existing phonological forms (Venezky, 1967, p. 104)." To determine how words are perceived, therefore, researchers turned to examine English orthography. Many linguists held written English to be simply a grossly irregular alphabetic system, and advocates of spelling reform argued that it affords only a low predictive correlation from spelling into sound (graphemes into phonemes).

Venezky (1967a) describes English orthography as containing two basic sets of patterns. The first is the internal structure of orthography: the classes of letters or graphemes and the allowable sequences of these classes (graphotactics). The second, and the more complex, is the set of patterns which relate spelling to sound. Both types of patterns will be examined here.

Graphotactics

Spelling patterns are structured in much the same sense that the term was used in Miller's (1958) experiment on redundant letter strings. For instance, certain clusters of letters can begin a word (e.g., QU or CR) but may not end it; others may end it but not begin it (e.g., CK). These are rules stating redundancy of a special sort found in English spelling. Fries (1963) while agreeing that single letters have never matched single sound features, stressed the fact that English has word patterns represented by spelling patterns. These basic patterns, according to Fries, consist of monosyllabic words spelled regularly with a very simple pattern such as (C)VC where C stands for a consonant or consonant cluster; V for a vowel or dipthong; and the brackets refer to being optional. Thus letters do not occur at random in English words, but follow regular patterns. The second set of patterns, those which relate spelling to sound, will now be discussed.

Grapheme-Phoneme Correspondence

There appears to be a regularity not only in the ordering of letters, but also in the way in which groups of letters relate to sound patterns. Ausubel (1967) contended that because of the alphabetic structuring of English, written words are not just configurations of visual symbols that arbitrarily represent their auditory counterpart. Rather, "there is a more or less lawful relationship between the combination of distinguishable sounds (phonemes) constituting the spoken word, and the analogous combination of letters (graphemes) constituting the corresponding written word (p. 545)."

Hanna initiated a research study (Moore, 1951) in which a 3,000-word vocabulary was analyzed in terms of phoneme-grapheme correspondences, which were classified as either "regular" or "irregular", and the relative frequency of the correspondences was noted. Findings showed that approximately 80% of the phonemes contained in the words comprising the traditional spelling vocabulary of the elementary school child approximate the alphabetic principle in their letter representation. The results of this study indicated that our written code is consistent to the degre that analysis of phoneme-grapheme correspondences could feasibly provide the basis for teaching spelling (Hanna, Hodges & Hanna, 1971).

Criticism of the corpus size in the Hanna-Moore study prompted the analysis of the sound-letter relationships of a core vocabulary of 17,000 words (Hanna, Hanna, Hodges & Rudorf, 1966). Results of this project confirmed the earlier research findings and demonstrated an even greater consistency of phoneme-grapheme correspondence. It was found that the majority of consonants had single spellings which were used 80% of the time although only a few vowel sounds had single spellings which occurred with such high frequency. The effect of position and stress increased the sound-symbol correspondence. This study indicated that, contrary to traditional viewpoints, orthography is far from erratic. It is based on phoneme-grapheme relationships which, although complex, are largely systematic.

The same group of researchers undertook a second investigation to test the algorithm devised from their previous findings, in which a computer was programmed to spell the 17,000 words. The nearly 50% accuracy results indicate that almost half the words in ordinary usage can be correctly spelled solely on the basis of a functional understanding of the relationships between spoken sound and written symbol (Hanna, Hodges & Hanna, 1971).

The existence of a correspondence between sound and symbol based on a larger unit than the individual letter was shown by Hockett and his co-workers (1960) as quoted by Gibson, Osser and Pick (1963). They classified graphic monosyllables (a) according to the arrangements of letters in items and (b) in terms of their pronunciation. The aim of the classification was to discover the rules by which pronunciation can be predicted by spelling. They found that rules for pronunciation are found to be quite regular when formulated conditionally on the letters preceding and following as well as the letter group itself.

Venezky's (1967a, 1967b) analysis of grapheme-phoneme correspondence in the 20,000 most common English words supports Hockett's study, also showing that English orthography is a more regular and more complex system than was previously believed. These correspondence, he explained, have predictability, if rules are sought in higher-order units rather than in single letters. For example, in the word "weight", "Eigh" might be considered a vowel spelling for mapping purposes. Position contingencies of spelling were also found to be important for prediction and pronounciation - what precedes and what follows a vowel spelling, or whether a consonant cluster is at the end or the beginning of a word.

> Current research indicates that the traditional view which held that American-English orthography was essentially irregular can no longer be maintained. The research of Bloomfield, Hanna and Moore, Rudorf, Hodges....and others has satisfactorily demonstrated that a considerable portion of phoneme-grapheme relationships are regular (Cramer, 1968, p. 58).

Clusters of phonemes do map with considerable regularity to clusters of letters. These linguistic findings were utilized by those primarily interested in the unit of perception used in word identification.

III. THE SEARCH FOR HIGHER ORDER UNITS

"It appears that clusters of letters do have invariant relationships with sound patterns and it has been suggested that 'spelling patterns' are critical units for perception (Williams & Levin, 1967)." A letter is read in its context and not responded to in isolation. "It is a well-known fact that when the eye jumps from one fixation to another in reading, it takes in a whole group of letters during each fixation (Gibson, 1969, p. 438)." Experiments by Newman (1966) and by Kolers and Katzman (1966) demonstrated that when letters forming a familiar word are exposed successively in the same place, it is almost impossible to read the word. These findings indicate that words are not processed letter-by-letter, but that they are perceived as letter groups or clusters. In short, we perceive graphic symbols in larger units which have a closer correspondence to phonemic patterns than the individual letter, and are hence called higher order units. We see these units as "chunks" as Miller (1956) has called them. "The letter chunks are not available at once to the beginning reader, and we know very little about how he attains skill at grasping them (Gibson, 1969, p. 437)."

The question is, what are the grouping principles or structures that yield higher order units than the letter in reading. It was reasoned that if a unit was utilized in the perception of words, the availability of those words would improve or facilitate actual word perception.

The following research concerns itself with determining how the orthographic structure and sound symbol patterns of English facilitates word perception. Much use in these studies is made of nonsense words (a) to omit the variable of word familiarity and (b) to determine the transfer value of verbal learning, for, according to Hall (1964):

> The ultimate test of any method of teaching reading is whether the learners can deal with nonsense-syllables; if a child cannot read off 'glump', 'trib', or 'donk', not caring whether these syllables have a real-life meaning or not, the method has failed (p. 432).

IV. THE ROLE OF GRAPHEME-PHONEME CORRESPONDENCES IN THE PERCEPTION OF WORDS

Studies by Gibson, Pick, Osser and Hammond (1962), and Gibson, Osser, and Pick (1963) serve as the basis for the investigation into the role that grapheme-phoneme correspondences play in the perception of words, and as such will be reviewed in depth. Questions raised and further studies initiated by the work of Gibson and her associates will also be examined.

Gibson and her co-workers hypothesized that the critical unit of language for the reading process is constituted by spelling-to-sound correlations, the higher-order units formed by grapheme-phoneme correspondences. These units are letter-groups having an invariant relationship with a phonemic pattern. They may be of different sizes, and the rules for the grapheme-phoneme correspondence are conditional on what precedes or what follows. These rules of correspondence are those found in the structure of written English as it it related to spoken English (as described by Venezky, 1967). According to Gibson, "reading consists of decoding graphic material to the phonemic patterns of spoken language which have already been mastered when reading is begun (p. 555)." The hypothesis she advanced was that the reading task is essentially that of discovering the spelling-to-sound correlations, and that as an individual learns to read, he discovers these grapheme-phoneme correspondences. Although it is unlikely that he could formulate them, it was felt that these rules become functional units, when applied to reading new words. Thus it was predicted that a skilled reader should discriminate better visually, pseudo-words which are constructed according to the rules of spelling-to-sound correlation (i.e. that structural constraints facilitate perception).

To test this hypothesis, Gibson et al. (1962) constructed two sets of pseuod-words. One set contained strings of four to ten letters, which conformed to English spelling patterns although they were not real words, and were referred to as pronounceable. An example of a pronounceable string is GLURCK. A second set of letter strings which did not conform to rules of English orthography was formed by reversing the initial and final consonant clusters, but leaving the medial vowel cluster in the same position, and resulted in what were referred to as unpronounceable pseudo-words such as CKURGL.

Twenty-five college students wrote down words from both these lists which were presented tachistoscopically in random order, in five successive presentations with an exposure time beginning at 50 ms. and progressing up to 250 ms. The mean percentage of pronounceable words correctly perceived was consistently and significantly greater (at the .01 level) at all exposure times than the mean percentage of the unpronounceable words.

Replication of the same experiment using sixty college students with a different judgement (matching from a four-item multiple choice list) gave the same results.

Gibson et al. (1962) concluded, therefore, that skilled readers are more apt to perceive correctly letter strings which follow the rules of grapheme-phoneme correspondence than those that do not.

These results were obtained with adult subjects, and did not answer when nor how these structural constraints are picked up by the child learning to read. To this end, Gibson et al.(1963) compared the knowledge of grapheme-phoneme correspondence in children at the end of first and third grades, using twenty-four subjects (twelve boys and twelve girls). Three-letter words, pronounceable trigrams, and unpronounceable trigrams were exposed tachistoscopically as in the previous experiment. The words, which were taken from the first-grade reading list, were re-arranged to form a meaningless but pronounceable trigram as well as a meaningless but unpronounceable one (e.g., RAN, NAR, RNA). Some longer pseudo-words (four and five letters) taken from the previous experiment were also included. The first-graders perceived most accurately the familiar three-letter words. The unpronounceable trigrams resulted in most errors, and the pronounceable trigrams were intermediate. The longer pseudo-words were seldom perceived accurately by first graders and the pronounceable ones were equally difficult for them. By the end of the third grade, many children perceived all the three-letter combination with high and nearly equal accuracy. Of the longer pseudo-words, however, the pronounceable ones were correctly perceived significantly more often than their unpronounceable counterparts.

The results of this experiment led Gibson and her co-workers to conclude that a child in the early stages of reading development, reads in short units, but is beginning to generalize certain regularities of spelling and spelling-to-sound (grapheme-phoneme) correspondences, which facilitates perception and recall of words containing these correspondences.

This finding was supported by Levin and Biemiller (1968), who studied the formation of these higher order units developmentally. They asked second-, third-, and fourth-grade children to read three types of words. In the first two types, the words began with an initial consonant whose pronunciation was dependent (contingent) on the subsequent letter, i.e., Type I, Contingent-Uncommon: words having the less common pronunciation of the initial letter, e.g., celt; Type II, Contingent-Common: words having the more frequent pronunciation, e.g., colt. In the third type, Noncontingent, the first letter had an invariant correspondence to speech and its pronunciation did not depend on its environment, e.g., belt. It was found that the children took longer to read words with contingent-uncommon spellings. This led the researchers to conclude that word identification is affected to some degree by letter dependencies (contingencies). It was interpreted that the children had learned only one correspondence pattern for those letters requiring the knowledge of the following letter, but were having difficulty with the pattern with which they had not had much experience. This finding gave further support to the notion that there is a gradual development of higher order units for word perception.

Other researchers began to question whether pronounceability was a prime factor in the perception of invariant grapheme-phoneme correspondences, or whether perhaps frequency or some other factor might be of greater importance.

V. THE PRONOUNCEABILITY-FREQUENCY DEBATE

The familiarity of a word is determined by its frequency of occurrence and usage in the written language to which a child is exposed. Thus, the higher the frequency of a word, the more familiar it should be to the reader.

It has been shown (Howes & Solomon, 1951; Postman & Rosenweig, 1957) that word familiarity is a powerful determinant of ease of perceptual recognition when a word is exposed for a brief period of time. Gibson (1962,1963) had not used actual words in her studies; therefore word familiarity or frequency of occurrence could not have been a factor in ease of identification of the grapheme-phoneme correspondences. Was it possible that the familiarity of the parts within those words could be a more important determinant than pronounceability?

Frequency of the various parts of a word can also be analyzed. Two-letter groups (digrams) or three-letter groups (trigrams) occur with varying frequency in written language. (GN, for example, occurs less frequently than TE.)

Anisfeld (1964) criticized the interpretation of the Gibson et al. study (1962) that ease of recognition of words is based on pronounceability. His alternative interpretation was that the pronounceable words were also those with the higher summed digram and trigram frequencies. Thus, he reasoned, skilled readers may have identified the pronounceable words more easily on the basis of higher digram or trigram frequencies rather than on the basis of pronounceability.

He found (except for three items) that the word with a higher digram frequency had a higher recognition score than the correspondent word with a lower digram frequency (significant beyond the .01 level).

Gibson (1964) replied to Anisfeld's comments indicating that because the test items varied in length, the longer words would have greater summed frequency. Mere sums would give a bias toward a negative correlation. Using the mean summed digram and trigram frequency for each item and correlating it with the number of correct perceptions yielded no significance.

Postman and Conger (1954) had found no relation between trigram frequency and speed of recognition. They, however, used three-letter items whereas Gibson used longer items. Postman and Rosenzweig (1957) had also conducted research that dealt with conditions that determine the perceptual recognition of verbal stimuli and found no relationship between recognition thresholds and trigram frequency.

Mayzner and Tresselt (1962) studied college students' ability to rank letter pairs and single letters to match digram and single-letter frequency counts that were based on word length and letter-position. The results indicated that the subjects were able to successfully rank the frequency with which digrams and single-letters occur in the language.

This led Biederman (1966) to study the recognition of tachistoscopically presented five-letter words as a function of digram frequency. With the sixteen college students, Biederman found that for words of high frequency, there was no difference in the ease of recognition between high digram frequency words and low digram frequency words. However, for words of low frequency, high digram frequency words were recognized in fewer trials than low digram frequency words.

This research seems to indicate that given words of low frequency, or perhaps even pseudo-words with a no-word frequency value, the words comprised of high digram or trigram frequency would be recognized more often than a lower digram or trigram frequency based word.

The question of relative importance of frequency and pronunciation was not completely clarified. To do this, two further studies were conducted by Gibson and her associates. Gibson, Bishop, Schiff, and Smith (1964) compared three types of trigrams to determine the effects of meaningfulness and pronounceability as grouping principles in the perception and retention of words. The pronounceable trigrams were found to require the lowest perceptual threshold for accurate perception (under tachistoscopic conditions), meaningful trigrams followed, and the control trigrams (low in both pronounceability and meaningfulness) required the highest perceptual threshold. This study can be criticized in the light of the ratings for pronounceability, which were done by other subjects than those used in her study. These subjects, who did the ratings, moreover, were college students whereas the words were sometimes used with elementary students.

To shed further light on the role of the sound correspondencies in the perception of words and in abstracting spelling patterns, Gibson, Shurcliff and Yonas (1966) decided to use deaf subjects. If pronunciation was of vital importance in the recognition of spelling patterns, it seemed that deaf subjects should be handicapped. The experiment with pronounceable and unpronounceable pseudo-words was therefore repeated with college students who were congenitally deaf or else had lost their hearing before learning to read. Although the deaf subjects read fewer pseudo-words in toto correctly, there was, however, a similar difference between the potentially pronounceable pseudo-words and the unpronounceable ones. That is, the pronounceable pseudo-words required the lowest perceptual threshold for accurate perception. It appeared that the deaf students had acquired higher order units even though they had never heard the sounds to which the letters mapped. Research to this point had focused on grapheme-phoneme correspondence or the relation of sounds to letter patterns, but this study suggested that the relationship with sound might not be as important as was previously believed. Gibson (1969) concluded that, as the deaf subjects had profited just as much as the hearing subjects, that spelling patterns alone must therefore provide regularities that are used in reading.

> Our term 'pronounceable' was perhaps misleading, since the spelling rules can function independently of pronunciation. But the hearing subjects did read more words, on the average, and so it is likely that redundant invariant sound correspondences can be facilitating when they are available to the learner (p.440).

Thus focus turned slightly away from grapheme-phoneme correspondences per se, and toward the perception of spelling patterns referred to by Venezky (1967a) as graphotactics.

VI. THE ROLE OF SPELLING PATTERNS IN THE PERCEPTION OF WORDS

As research suggested that spelling patterns might provide regularities that are used in reading, further investigation was carried out on the effect of spelling patterns on the perception of words. Postman and Rosenzweig (1957) found that their subjects had a tendency to complete partially discriminable items, if the items were of high frequency. Thus, once a subject had recognized two letters, he was able to supply the missing letter and to reconstruct the word. Postman and Rosenzweig concluded that each letter appeared to carry a smaller amount of information after training. This finding can be explained by the concept of redundancy. Letter redundancy is a kind of prior knowledge which reduces the alternative number of possibilities that a letter can be. For example, to an experienced reader of English, if the first letter of a word is T, the next letter will almost certainly be H, R, W, or a vowel. Knowledge of spelling patterns, then, gives the reader an idea of which letters are more likely to follow. In terms of communication theory, Smith (1971) explains:

> Knowledge of the way in which letters are grouped into words may be called orthographic information. This information, which is located within the brain

> of the fluent reader, is an alternative source of information to the visual or featural information that the reader's eyes can pick up from the page. To the extent that both of these courses of information reduce the number of alternatives that a particular letter might be, there is redundancy. Such duplication of information may be called sequential redundancy because its source lies in the fact that the different parts of a word are not independent; the occurrence of particular alternatives in one part of a sequence limits the range of alternatives that can occur anywhere else in the sequence (p. 133).

The idea of redundancy allows for another interpretation of the Cattell data. Smith and Lott (1971) suggest that as redundancy is added to a sequence of letters, the good reader picks up bigger units. This implies that the visual system processes more information if the stimulus can be chunked or 'coded'. Miller (1956) introduced the concept of the facilitation of recall by chunking. In 1958 he showed that redundant strings of letters as opposed to random ones have an advantage in recall of the strings.

Redundancy explains, in part, how knowledge of spelling patterns could facilitate word identification. Research supports the fact that awareness of these patterns is utilized in reading words. It appears that letters are more easily identified when they appear in a sequence of letters than if they occur in isolation - assuming, of course, that the sequence is acceptable to rules of English orthography.

Wallach (1963) exposed nonsense words with varying degrees of approximation to English to grade five pupils. Good spellers were able to identify words of a higher order approximation significantly faster than poor spellers. Thus it would appear that good spellers not only have learned the sequential redundancy of letters, but are also able to transfer this knowledge to the reading of new words.

To determine the letter sequence habits of children, Amster and Keppel (1968) compared grade two, five, and college students in their ability to complete a word with the letter which would best follow. The data showed an increasing ability with age to make meaningful units or words, as well as to provide a letter which most frequently follows in orthographic structure.

The ability to make use of sequential redundancy seems to be based on an acquired implicit knowledge of word structure. Smith and Lott (1971) studied how children in grades one and four developed adult-like skills in the use of sequential redundancy in the recognition of familiar three-letter words, using controlled light intensity. All groups tended to identify letters within words at a lower light intensity level than the level at which they were able to identify letters in isolation. They found that children appeared able to use sequential redundancy in the identification of letters in the familiar three-letter words even in grade one, and by grade four achieved an adult level of performance. It led them to conclude that information from one part of a word facilitates the identification of other parts or letters of that word.

Thus it would appear that younger children have acquired an awareness of orthographic structure and of sequences of letters that can occur together.

VII. ACQUISITION OF AWARENESS OF SPELLING PATTERNS

Gibson (1970), convinced that rule-like information in orthography structures the units for reading, wanted to know how these rules or spelling patterns are learned and at what time in a child's development. Gibson, Farber, and Shepela (1967), as described in Gibson (1970), constructed sorting problems using words containing two-letter clusters in an invariant position. They trained and then tested kindergarten and first-grade children, and found that about half of the first-grade sample showed evidence of developing a learning set to abstract common patterns of orthography. This set appeared to be absent in the kindergarten children.

Rosinski and Wheeler (1972) further investigated the extraction of English spelling patterns which are then used as units in word perception by children. To more closely approximate an actual reading situation, they used a simultaneous discrimination task rather than the tachistoscopic recognition type of task used by Gibson in her series of experiments. Forty-eight subjects were used, sixteen from each of grades one, two, and three, with an equal number of boys and girls at each grade level. Twenty nonsense words of three, four, five and six letters in length were randomly selected from the tests given in Gibson et al. (1962, 1963). Within each length category, the pronounceable and un-pronounceable variants of each word were randomly paired. Subjects were told to choose the word of the pair that was "more like a real word". Results indicated no sex differentiation. First-grade children performed virtually at chance level, indicating that their recognition performance was not affected by English spelling patterns. This result differed from Gibson's (1967) findings of partial affect at the grade one level, but her study was conducted at the end of the school year. The Rosinski and Wheeler (1972) study was performed at the beginning of the first year. Thus, the extraction of English spelling patterns may occur some time within the first year of school.

Rosinski and Wheeler found that by third grade, children can distinguish pseudo-words which differ only in their adherence to English orthography. They concluded that children extract the orthographic structure of English words in the course of learning to read, and that this extraction takes place between the beginning of the first and third grade. A levelling off of this ability appeared at the grade three level. During the third grade most children can differentiate combinations of letters that follow the rules of orthographic structure and those which do not.

Heck (1972) referred to these orthographically-acceptable letter combinations and permissible sequences (PS) and to their unacceptable counterparts as non-permissible sequences (NPS). In studying children's ability to identify and to construct PS and NPS, he found that at the grade two, three and four level students were able to select PS in word-like structures.

VIII. THE RELATIONSHIP BETWEEN PERMISSIBLE SEQUENCE AWARENESS AND READING ACHIEVEMENT

Research indicated that children extract spelling patterns in learning to read, and that knowledge of these patterns appears to aid word perception. Wallach (1963) found that children were sensitive to the arrangement of letters into sequences. In a study of fifth-grade children, he found a significant correlation between sensitivity to nonsense words of permissible letter patterns and reading achievement as measured by the Metropolitan Achievement Tests.

Heck (1972) investigated the relationship between reading achievement and knowledge of PS in second-, third-, and fourth-grade children. Ten achieving and ten non-achieving readers in each grade were tested on their ability both to select and to construct PS in word-like structures of English orthography. No significant difference was found between the mean scores of the achieving and non-achieving readers in each grade, although the grade two non-achieving readers correctly identified fewer PS, resulting in their performance differing significantly from both third- and fourth-graders. Little significant correlation was found between the ability to identify PS and reading achievement, except for the grade two and four non-achieving readers.

In constructing PS, only the performance of the grade four achieving and non-achieving readers differed significantly. Similarly, the grade two and four achieving readers were found to differ significantly in constructing PS. No significant correlations existed with reading achievement.

Heck did find that accuracy in identifying the NPS increased with grade. Because all the children in his sample were able to identify PS, Heck was unable to determine when this awareness develops in children. Rosinski and Wheeler (1972) stated that the extraction of orthographic structure takes place between the beginning of the first and third grade. Thus perhaps had Heck (1972) included first-grade students in his sample, this development might have been apparent.

Three possible explanations for the low correlation found between reading achievement and awareness of PS are suggested. The first lies in Heck's scoring procedures, which it is suggested, did not measure children's ability to differentiate PS from NPS. Furthermore, it raised the chance factor to 2:3 for any child's guessing the correct answer. This was because the test required the subject to select a PS from three word-like structures. Two of the three items were PS.

A second explanation for Heck's low correlation might lie in the size of his sample, ten achieving and ten non-achieving readers at each grade. "The most effective way of gaining precision is to increase the sampling size (Helmstadter, 1970, p. 33)."

The third possible explanation lies in Heck's choice of the reading measure. Heck chose the Gates-McGinitie silent reading comprehension subtest as a measure of reading achievement. Although one might be inclined to feel comprehension to be the broadest measure of reading, it is not the only one. Other factors, such as word identification and phonics may also be used as measures of reading ability. It should be held in mind that Heck's correlation was between orthographic structure and silent reading comprehension, rather than with all aspects of reading.

IX. THE RELATIONSHIP BETWEEN AWARENESS OF PERMISSIBLE SEQUENCES AND SPELLING ACHIEVEMENT

Although much research to this point has related spelling patterns to the perception of words (i.e. the decoding of words), little research considering the relationship between orthographic structure and spelling ability has been elicited.

Wallach (1963) used fifty-five fifth-grade children to determine the relationship between spelling ability and sensitivity to the arrangement of letters into sequences. He predicted a relationship between accurately recognizing nonsense words that resemble English and spelling achievement. Two main kinds of six-letter words were tachistoscopically exposed to each child, i.e. words of zero-order and words of fourth-order approximation to English Nonsense words of zero-order approximation to English are constructed by a random sampling of the letters in the alphabet. First-order approximations, constructed by a random sampling of letters from English prose, contain letters in relative frequencies proportional to their likelihood of occurrence in the language, but the sequential structure of these letters is essentially random. In the construction of second-order approximation, the choice of each letter is governed by the previous letter, for a third-order approximation it is the previous two letters, and for a fourth-order approximation, the previous three letters. As fourth-order approximations contain three consecutive letters which occur in that order in written language, they are therefore closest to English in terms of their spelling patterns.

Wallach (1963) measured the degree of increase in recognition accuracy for potentially familiar nonsense words in contrast to potentially unfamiliar nonsense words through a comparison of results for the fourth-order and zero-order (approximation to English) words in the test series. Results indicated a correlation between scores of this measure and spelling achievement scores significant beyond the .001 level.

> These results are consistent with the proposition that good spellers in contrast to poor spellers, are learning not just to spell particular words, but rather also are learning a much more general property of English words - namely the transitional probability structure governing the sequential arrangement of letters in such words (p. 61).

Thus, the good spellers were learning the general structuring of PS. They were able to generalize information about English orthography and to transfer this knowledge to new words.

Wallin (1967) studied individual differences in knowledge of sequential rules, and related this knowledge to spelling ability. He tested two-hundred and twenty-six ten-year-olds' ability in spelling words of first-, second-, and third-order approximations to Swedish. Results of his study indicated that structural knowledge is of importance for spelling ability. This knowledge may consist of knowledge about phoneme-grapheme relations. "It may also be a knowledge of sequential rules (which are also of importance for phoneme-grapheme relations) that facilitates the perception of the words given (Wallin, 1967, p. 151)."

It appears that knowledge of the structural rules of the language, both distributional and sequential, is important, and that differences in ability to make use of these rules contributes to differences in spelling ability. Wallin suggests that by substitution of deleted letters, an individual's ability to use the language's contingent probabilities could be measured, and that this could be related to spelling.

X. THE RELATIONSHIP BETWEEN READING AND SPELLING

Research has indicated a relationship between PS awareness and spelling and a possible relationship between PS awareness and reading. These might suggest a relationship between reading and spelling. In fact, research has shown that there is a correlation between these two abilities.

Townsend (1947) investigated the relationship between spelling and reading comprehension using Metropolitan Achievement Test scores of 2,000 children in grade three through seven. Median correlation between reading comprehension and spelling for the group was .51.

Morrison and Perry (1959) found that the mean correlation between spelling scores and reading scores of vocabulary and comprehension, as measured by the California Achievement Tests, was .79 for the total sample of 1,000 children.

Spache (1941) conducted a thorough review of spelling-reading literature prior to 1941. He concluded that there is ample evidence that phonic knowledge plays an important part in spelling ability, and that a coefficient of .60 was typical of the association between vocabulary and spelling (as measured by the Metropolitan Achievement Test, the Stanford Achievement Test, and others).

Lefevre (1966) states that the relationship of spelling to reading is not well understood. "We do know that anyone who literally spells as he reads is not reading; that a good speller is not necessarily a good reader, nor a good reader a good speller (p. 301)."

This evidence points to a relationship between some aspects of reading and spelling. No research was found which correlated word identification ability per se and reading ability.

XI. SEX DIFFERENCES IN READING AND SPELLING

Little research has differentiated the sexes in measuring knowledge of orthographic structure. Other related language abilities which have separated boys' scores from girls' scores were considered to have implications for the present study.

In an early study of sex differences Samuels (1943) paired two-hundred first-grade boys and girls equated on mental and chronological ages. Significant differences were found in favour of the girls in every measurement of the Gates Primary Reading Test.

Gates (1961) conducted a large scale study of sex differences in reading over a ten state area. His population included 13,114 children in grades two through eight. These pupils were administered the Gates Reading Survey tests which included subtests of Reading Vocabulary and Comprehension. The results of the comparison of mean raw scores favoured girls at all grade levels.

Stroud and Lindquist (1942) tested three thousand to five thousand pupils in each grade from grades three to eight on the Iowa Every-Pupil Test of Basic Skills. Female superiority reached significance in reading vocabulary in grades three, four, five, and eight.

Other writers noted that more boys than girls became disabled readers. Alden, Sullivan and Durrell (1941) measured reading ability in six thousand three-hundred children in eleven states. They found a higher percentage of reading disability among boys than girls at each of the grade levels two through six.

Not all studies show differences in reading favouring girls, however. Sheldon, Nichols, and Lashinger (1967) found no differences in reading achievement when boys and girls of high ability were compared. Powell, O'Connor, and Deutsch (1963) found no significant differences in the scores of two thousand three-hundred and sixty-nine boys and two thousand three hundred and sixty-nine girls (grades three through eight) who took the California Reading Achievement Test. Clark (1959) used scores on the California Achievement Tests to compare boys and girls in grades three, five and eight. When he held intelligence and chronological age constant he found no reliable sex differences in the reading scores of these grades. He noted, however, that girls performed better in spelling.

Traxler and Spaulding (1954) noted that in numerous surveys employing the Stanford Achievement Tests the girls invariably excelled the boys in spelling and in language usage. Wallin (1967) cited several investigators, all of whom found that girls scored significantly higher than boys on Swedish spelling tests. Reid (1954), in summarizing the literature, concluded that girls show a consistent superiority in spelling. A later study by Wallach (1963), however, showed no difference in spelling ability of boys and girls in fifth grade.

Thus, although research points to the superiority of girls in reading and spelling, the results are not conclusive. No research was found which indicated a sex difference in abilities either to identify or to construct PS. This study, therefore, examined the relationship between girls' and boys' abilities in word identification, spelling, PS identification, and PS construction.

XII. SUMMARY

Research indicated that invariant grapheme-phoneme correspondences are identified more accurately than their variant counterparts. It would appear that the invariance is based upon units that have a consistent spelling-to-sound correlation. These correspondences appear to be assimilated by the reader at a very early stage of reading development. The orthographic structure of the word, rather than its pronunciation, seems to be the factor involved in the accurate identification of words containing such grapheme-phoneme correspondences.

Previous studies indicate that various aspects of reading are related to spelling. Knowledge of orthographic structure, it is suggested, facilitates spelling and word perception. Although word identification is the scholastic skill which most approximates word perception ability, no study has been done which examines the relationship between knowledge of orthographic structure and word identification. Heck (1972) examined the relationship between orthographic knowledge and reading comprehension, but the interrelationship between orthographic knowledge, spelling, and some aspect of reading had not yet been examined.

CHAPTER III

THE RESEARCH DESIGN

In this chapter, the experimental design of the study is described. Information regarding the sample, the test instruments, and the procedure used in the administration and scoring of the tests will be included. Results of the pilot study will be described, and information gained from the teacher questionnaire and interview will be summarized. A description of the treatment of the data by statistical procedures will also be discussed in this chapter.

I. THE SAMPLE

The subjects in this study were from one school in a mid-socioeconomic area, as designated by the Edmonton Public School Board. The students selected for this study came from nine classrooms, three classrooms of each of grades one, two, and three. No attempt was made to segregate achievement levels in the classrooms. The actual sample consisted of 90 children, 30 from each of the three grade levels, or ten from each of the nine classrooms. Of these 90 children, 42 were girls and 48 were boys, distributed amongst the grades as shown in Table I.

TABLE I

DISTRIBUTION OF BOYS AND GIRLS IN THE SAMPLE

	Grade One	Grade Two	Grade Three	Total
Girls	15	13	14	42
Boys	15	17	16	48

Socioeconomic Factor

A correct assessment of socioeconomic class is necessary in order to generalize the implications from the subjects in the study to a broader population. According to Havighurst (1967) "by knowing the social-class composition of a school or a classroom, a teacher can anticipate ... the general level of educational achievement (p. 10)." Therefore this investigator deemed it important to ascertain whether the school designated for this study did, in fact, draw its population from a mid-socioeconomic area. The school records were used to obtain the father's or guardian's occupation, which was categorized according to Blishen's Occupational Class Scale (Blishen et al., 1968). This scale is based on an analysis of education and income characteristic of incumbents of occupations drawn from the 1961 Canadian census. According to Blishen, the majority of subjects in the "mid" category would come from homes of skilled or semi-skilled workers.

The parents' occupations were found to cover a wide range, some examples of which were bus operator, geologist, salesman, lawyer, student, and teacher. The largest categories were those of "teacher" and "student." As the area was one which fed the University of Alberta, many parents were either employed by or attending the University. Categorically, more of the jobs were of a skilled than of a semi-skilled nature. It was concluded that children in this study were from a stratum slightly higher than mid-socioeconomic.

Language Factor

Some of the children in this area came from homes in which a language other than English was spoken. In studies of Alberta pupils, Robinson (1934) found that bilingual students experienced considerable difficulty with the English language. Chalmers (1935) discovered that bilingual Alberta pupils were definitely inferior to monoglots in both the identification and use of English vocabulary. This evidence led the investigator to believe that children who spoke a second language to any degree of fluency should be excluded from the present study.

The teachers of the nine classes involved in the study were asked to exclude those of their students who spoke a second language. As the children had been with their teachers for eight months by this time, the teachers were assumed to be familiar with the children and their background, and had had several parent-teacher interviews.

A second screening for subjects' knowledge of a second language was undertaken by the principal and the secretary, both of whom had been at the school for a number of years. They checked the list of subjects to exclude from the study any whose family was known to speak a second language.

As a third check, each child in the study was questioned individually by the investigator as to his knowledge of a second language. If one was indicated, the child was asked to speak a few words in the foreign tongue and to translate a few very basic words such as "one," "two," "three," "mother," "hello," and "thank you" into the second language. A child who was able to complete this simple task was excluded from the study.

Selection of the Sample

The sample was chosen after the exclusion of the children who were able to speak more than one language. From the remaining students, 10 children from each of the nine classes in grades one, two, and three were randomly selected to form the sample.

II. TEST INSTRUMENTS

As the purpose of this study was to investigate the relationship of abilities to identify and to construct both words and PS, instruments which would measure these abilities were needed. Standardized tests of word identification and spelling were selected for purposes of this study. As no measuring devices of PS had been standardized, Heck's (1972) tests devised to measure the ability to identify and to construct letter sequences were selected. The four instruments used in this study were:

(a) the Slosson Oral Reading Test (Slosson),

(b) The Graded Word Spelling Test B (Schonell),

(c) The Test of Orthographic Structure (Heck), and

(d) The Test of Letter Familiarity (Heck)

Two of these tests (Slosson Oral Reading and Graded Word Spelling) were standardized whereas two tests (Test of Orthographic Structure and Test of Letter Familiarity) were informal. One of the four tests, the Slosson Oral Reading Test, was administered in an individual setting, whereas the other three were administered in a group setting.

Standardized Tests

Slosson Oral Reading Test. This is an oral reading test designed to be given individually and is based on the ability to pronounce words at different levels of difficulty. The words were taken from standardized school readers and the reading level (grade score) obtained from testing represents median or standardized school achievement. A correlation of .96 was obtained with the Standardized Oral Reading Paragraphs by William S. Gray. A reliability co-efficient of .99 (test-retest interval of one week) was obtained for this test. A copy of the Slosson Oral Reading Test appears in Appendix A.

Graded Word Spelling Test B (Schonell). This test consists of 100 words of increasing difficulty and was used to give an indication of subjects' spelling level. It was constructed from a pool of words drawn from Schonell's Essential Spelling List and was given to approximately 2,000 (English) children, about 200 in each age group from 5 to 15 years of age. After elimination of words which were unsuitable in terms of statistical criteria, 10 words were chosen for each age group, each word having been spelled correctly by 45% to 55% of the age group. Reliability (test-retest on 195 children) was .96 (Nisbet, 1959). A copy of the Graded Word Spelling Test appears in Appendix B.

Informal Tests

The two informal instruments used in this study were based on those designed by Heck (1972) to measure knowledge of orthographic structure and redundancy.

Test of Orthographic Structure. This test was designed by Heck to determine children's awareness of the orthography of English. More specifically, it measures children's ability to identify PS and NPS. Each of the 15 test items was composed of two pseudo-words and one real word.

The real words were chosen from Hockett's (1963) list of spelling words comprised of invariant grapheme-phoneme correspondences. The frequency of these words was checked in the Teacher's Word Book of 30,000 Words (Thorndike, 1944) and the Word Frequency Book (Carroll, et al., 1971). The frequency of occurrence of these words was less than five times per million. The digram and trigram frequency of each real word was analyzed according to the tables of Mayzner and Tresselt (1965a, 1965b). As these words occurred so rarely, it was decided that they would be unfamiliar to the children and hence could also be considered pseudo-words.

A distractor of equal length and beginning with the same letter as the original word was constructed by Heck (1972). This distractor was comprised of an invariant grapheme-phoneme correspondence and had a frequency count that was opposite in value to the frequency count of the same number of letters in the real word. The purpose of the inclusion of this pseudo-word was to discover whether letter frequency affects the basis of an individual's choice.

A third distractor, also of equal length and beginning with the same letter as the original word was constructed for each item. This distractor contained a sequence of letters that does not occur in English orthography. The NPS was randomized to be in the initial, medial, or final positions (or a combination of any two positions).

Arrington's Formula was used to determine the reliability co-efficient of this test (Fiefel and Lorge, 1950). A test-retest was carried out using 12 children, two weeks after the initial testing. The reliability coefficient was computed at .67 for the grade two sample, .74 for the grade three sample, and .90 for the grade four sample.

This test was originally intended to be an individual one. For adaption to a group test, the order of items was left as it appears in Appendix A (Heck, 1972), while the order of the three word-like structures within each item was randomized. The test was then typed in lower-case letters of primary type, using triple-spacing between items, on two pages, as found in Appendix C.

Test of Letter Familiarity. This test was designed by Heck also to determine children's awareness of English orthography. More specifically it measures children's ability to construct PS and NPS. It consisted of 20 real words chosen in the exact manner that words were chosen for the Test of Orthographic Structure and which therefore were, functionally, pseudo-words. One letter was deleted from the sequence of letters comprising each word. For the deleted letter, three one-letter choices were provided. These choices consisted of:

(a) the missing letter from the real word,

(b) a letter forming a PS whose digram or trigram frequency count value was opposite to the real word

and (c) a letter forming an NPS or one that could not occur according to the rules of English orthography.

The description given by Heck indicated that the order of the three one-letter choices was randomized. The reliability co-efficient, determined by Arrington's formula, was found to be .68 for grade two, .71 for grade three, and .76 for grade four. For the present study, the same order was used as originally designed, but the test was re-typed with more (three) spaces between each item on two pages, using primary type and lower-case letters. A copy of the test appears in Appendix D.

III. PILOT STUDY

A pilot study was undertaken in February, 1973 in Port Cartier, Quebec, using 25 children from each of grades one, two and three for the group tests, and using ten children from each of the three grades for the individualized test. The language factor was considered only minimally. Only fully bilingual children were omitted from the sample because:

(a) the results of the four tests were not to be analyzed in depth,

(b) almost all of the sample spoke a certain amount of French due to the geographic location,

and (c) the pilot study was seeking information about factors not believed to be affected bv a knowledge of a language other than English.

The purposes of the pilot studv were, then:

(a) to determine the average amount of time taken to give each of the four tests at each of the three grade levels,

(b) to determine which of two word recognition tests was more suitable to children of this age group (6, 7, and 8 vears),

(c) to determine if the new format (as opposed to Heck's) used in the Tests of Orthographic Structure and Letter Familiarity would present any procedural difficulties to the children,

and (d) to determine if grade one children were able to follow the instructions and to complete the Tests of Orthographic Structure and Letter Familiaritv.

From results of the pilot study, it appeared that the group tests took varying amounts of time to administer at the different grade levels. The individualized test was found to take approximately 10 minutes per child regardless of grade level, although this varied somewhat with ability. These findings were used in determining the testing schedule of the main experiment.

Two measures of word identification were considered for the main experiment, the Schonell Graded Word Reading Test and the Slosson Oral Reading Test. Both tests were administered to each of the 30 subjects in the pilot study. The order of the tests was alternated to eliminate a possible practice effect.

The Schonell test included only 10 words at each grade level, from grades one to ten. Consequently, a child's performance in the test was determined from a small sampling of his ability. The Slosson test, on the other hand, consisted of 20 words at each grade level with an additional 20 words at the primer level. As scores in this latter test are based on a large number of words, the Slosson test was felt to give a more accurate representation of a child's ability, particularly at the primary level, than the Schonell test. It should be noted that scores on the Slosson test were consistently higher than scores on the Schonell test, in the pilot study.

Minor changes were made in the format of Heck's informal tests for purposes of this study, to accommodate the grade one students. Heck had originally designed these two instruments for individual administration to grades two, three, and four. In this study it was decided to give them as group tests to each of grades one, two, and three. The modifications, then, were made to facilitate administration to a younger grade as well as to a large group.

Each item on the Test of Orthographic Structure was presented by Heck on an individual three - by five - inch card, in random order. For adaption to a group test, the order of items was left as they appeared in Heck's Appendix A, while the order of the word-like structures within each item was randomized. (The order of every third item was reversed). The revised Test of Orthographic Structure was then typed in lower-case letters using primary type, and triple - spacing between items, on two pages.

The Test of Letter Familiarity was left as it appears in Heck's Appendix B, but was retyped with more (three) spaces between each item as it was felt that the original test might pose some difficulty for children in grade one. The revised version of the Test of Letter Familiarity covered two pages using primary type.

In the pilot study children at all three grade levels appeared to understand the directions and to have no difficulty with the format of the informal tests. Results of the tests (through scanning) indicated that the tests were not so difficult as to prevent the student's comprehension and completion of the task.

From findings of the pilot study, it was concluded that the new format could be used in the main experiment and that the revised versions of the Tests of Orthographic Structure and Letter Familiarity were suitable as group tests and could be administered to grades one, two, and three.

IV. TEST PROCEDURE

Ten students were chosen from each of three classes at each grade level. Students at each grade level were grouped for three of the four tests. Thus tests were administered to thirty children at a time, who were all of the same grade. This was done to facilitate scheduling, as the pilot study indicated that children in different grades took varying amounts of time to complete the group tests. All testing took place in the last two weeks in April.

Group Tests.

The order of the administration of these tests was changed for each of the three grades. This was done to reduce the possible effects of practice and transfer learning among the Test of Orthographic Structure, the Test of Letter Familiarity, and the Spelling Test.

TABLE II

SEQUENTIAL ORDERING OF GROUP TESTS

Grade	1st Test	2nd Test	3rd Test
1	OS[1]	Sp	LF
2	LF[2]	OS	Sp
3	Sp[3]	LF	OS

[1] Orthographic Structure; [2] Letter Familiarity; [3] Spelling

All tests were given in one week in the mornings at either 9:00 or 10:30. The time at which grades were administered tests was also varied, so that a possible effect of fatigue during the later period of testing would be minimized. Temporal ordering of the tests was also arranged so that all grades had tests at the beginning and end of the week, and no grade had two tests on any one day.

TABLE III

TEMPORAL ORDERING OF GROUP TESTS

Days	9:00	10:30
Mon.	grade 1	grade 2
Tues.	grade 3	grade 1
Wed.	grade 2	grade 3
Thurs.	grade 1	grade 2
Fri.		grade 3

Individual Test

The Slosson Oral Reading Test, taking approximately 10 minutes per child, was administered individually. The order was randomized by selecting one child from each of the classes in grade one, then one child in each of the grade two and grade three classes consecutively.

Instructions

The administration of the tests was held constant by using the same set of instructions for all students. These instructions were read by the investigator and are explained here.

Graded Word Spelling Test B. After the children were seated at a desk and were given numbered paper, they received the following instructions:

> Today I am giving you a spelling test. I will say the word to you. Then I will say the word in a sentence. Then I will say the word again for you. At first the words will be fairly easy. Later on they will get harder. Try to spell all the words.

Children occasionally raised their hands and asked that the word~~s~~ be repeated. The examiner always complied. The words were read to the children in the fashion explained in the instructions. Each word was embedded in an explanatory sentence. The same set of sentences was read for testing at each of the three grade levels. The examiner walked slowly around the room, picking up the papers of those who had made at least 10 consecutive errors, until all the children had finished.

Test of Orthographic Structure. Heck did not indicate the instructions he used in his study. Instructions given in the present study for this test, were as follows:

> Do you know what a nonsense word is? It is a home-made word. (Discuss). I am going to give you a paper that has lots of home-made words on it. (Pause for distribution). Look at number one. I want you to choose the word that looks most like it could be a real word. Circle that word. (Pause, during which time the examiner checked that all children had understood the directions). Now choose the word in number one that looks like it could not be a real word. Put a cross through it like this. (Here the examiner drew an X on the board. Again the examiner checked children's understanding of the directions). Now do the same for the rest of the numbers.

The children appeared to understand these directions. They were only asked to do the rest of the items after everyone had completed the first example.

At the end of the test, the children were asked to check to see that each item had one word circled and one word crossed out. The tests were checked by the examiner as they were collected, and a few children completed omissions at this time.

Test of Letter Familiarity. Heck (1972) used the following instructions for his administration of the Test of Letter Familiarity:

> Look carefully at each word below. In each word one letter is missing. Following the word, three letters are given. Pick the letter which you think would best fit in the blank to make an English word, even though you may not know the word or its meaning. Write the best letter in the blank (p. 54).

It was decided to alter these instructions for the present study for the following reasons:

1. For scoring purposes used in this study it was necessary to have the children choose both a PS and an NPS, not just a PS.
2. The fourth sentence in Heck's instructions is a rather complex compound sentence. Robertson (1966) has shown that children have difficulties understanding connectors. It was decided to simplify the wording of the instructions.

The following set of instructions was used:

> Do you know what a nonsense word is? It is a home-made word. (Discuss). I'm going to ask you to make up nonsense words for me. (Pause for distribution of papers).

> In number one you see a home-made word with one letter missing. Beside the word are three letters. Choose the letter to make it look most like it could be a real word. (Pause). Put that letter in the blank. (Pause during which time the examiner checked that the children had understood the directions). Now choose the letter that couldn't make it look like a real word. (Pause). Put a cross through that letter like this. (Here the examiner drew an X on the board. Again the children's understanding of the directions was checked). Now do the same for the rest of the numbers.

The children appeared to have little difficulty understanding these directions. Papers were checked before submission as in the Test of Orthographic Structure.

Slosson Oral Reading Test. Subjects were administered this test individually and the instructions used were the standardized ones:

> I want to see how many of these words you can read. Please begin here and read each word aloud as carefully as you can. (Indicate at what list to start). When you come to a difficult word, do the best you can and if you can't read it,... go on to the next one. (Test Manual, Slosson Oral Reading Test).

Each child was started with a list of which the examiner felt all 20 words could be read correctly. If the child was unable to do this, a simpler list was indicated, until a basal level (all 20 words correctly read) was established. In a few cases, children were unable even to read all 20 of the primer words correctly. After establishing a basal level, all words were read consecutively by the child until he mispronounced or was unable to read 20 consecutive words, at which point the testing ended. Reading Level was calculated by the standardized conversion table.

V. QUESTIONNAIRE AND INTERVIEW

The nine regular teachers of the subjects completed a questionnaire (Appendix E) and were interviewed individually, to assess the orientation of the children's language arts programme. Results of the findings are discussed here.

Questionnaire

All classes were taught by the basal reader approach, although none of the classes used only this method. Many of the classes, for instance, utilized several (as many as five) different basal readers. All classes had a separate programme for phonics, which was usually integrated into the reading programme. It appeared that phonics was heavily emphasized in all classes. Most classes also had a language programme, studying the patterns of language.

Interview

In interviews with the teachers, all but one said that phonics was heavily stressed in their language arts programme. Children were encouraged to sound out words and to synthesize these sounds into words, although some "see-and-say" methods were used at the initial stages in grade one.

The average time spent on reading was from one hour to one and one-half hours per day.

In all of the grade one classes, and in one of the grade three classes, spelling was not taught as a separate subject using a special programme. Instead, spelling programmes in these classes were integrated with the readers and phonics programmes. In the other classes a variety of other spelling sources were used, the most common of which was Kottemeyer, a phonically oriented programme.

It was concluded from information obtained by the questionnaire and by the interview with the teachers of the children in this study, that the language arts programme heavily exmphasized the phonics approach to reading. One would expect, therefore, that children might be able to identify and to spell words which were unfamiliar to them.

VI. ANALYSIS OF DATA

All the tests were administered and hand-scored by the investigator. The information obtained from the testing of each child was coded, punched on data cards and processed by computer by the Division of Educational Research Services at the University of Alberta.

Pearson Product Moment Correlations (Dest 02)

Using this test, correlation matrices were completed over grades, sex and the total sample for:

(a) word identification achievement,

(b) spelling achievement,

(c) ability to identify PS, and

(d) ability to construct PS.

The four basic correlations are between abilities to identify and to construct real words (as measured by the standardized tests) and to identify and to construct PS of letters (as measured by the non-standardized tests). The relationship between these four abilities is outlined in Figure I.

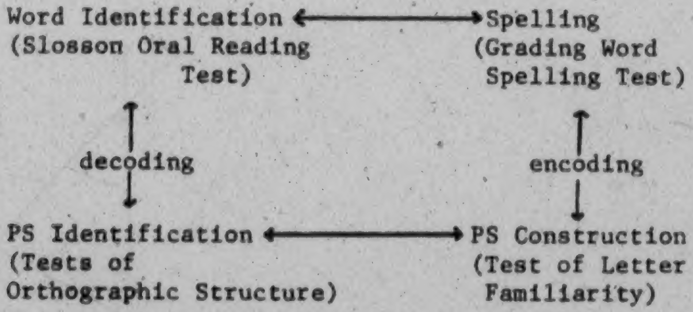
Word Identification
(Slosson Oral Reading Test)
Spelling
(Grading Word Spelling Test)
decoding
encoding
PS Identification
(Tests of Orthographic Structure)
PS Construction
(Test of Letter Familiarity)

Figure 1. Test Correlations

One Way Analysis of Variance (ANOV 15)

This one-way analysis of variance was used to determine whether differences existed between:

(a) each of the grades in their ability to identify words and PS, and to construct words and PS,

(b) each of the grades in their choice of high or low frequency PS, and

(c) the top achievers and bottom achievers of the four tests in each grade and in the total group, and their choice of high or low frequency PS.

Scheffé Multiple Comparison of Means (ANOV 15)

This procedure was used as a comparison of means following the above analysis of variance. In this manner it could be determined whether there were significant differences between the means.

VIII. SUMMARY

Thirty children from each of grades one, two, and three were randomly selected from nine classes in an Edmonton Public School to constitute the sample. Factors other than grade which were taken into account were:

(a) age,
(b) sex,
(c) socio-economic status (of parents),
(d) language,
(e) general achievement (by heteronenous classes), and
(f) reading and language approach.

A pilot study was undertaken to determine the suitability of the tests.

The test instruments were:

(a) the Slosson Oral Reading Test (individual),
(b) the Schonell Graded Spelling Reading Test B (group),
(c) the Test of Orthographic Structure (group),
and (d) the Test of Letter Familiarity (group).

The nine teachers of the subjects were interviewed individually and completed a questionnaire to determine the reading and language approach used and the emphasis placed on reading.

The results of the tests were tabulated and the data analysed with the aid of the Division of Educational Services at the University of Alberta.

CHAPTER IV

THE FINDINGS OF THE STUDY

The first section of this chapter presents the findings of the study with respect to the five null hypotheses. Students' behaviour during the tests is reported. Additional findings of the study are discussed in the second section of the chapter.

I. THE FINDINGS WITH RESPECT TO THE HYPOTHESES

Hypothesis One

> There is no significant correlation in each of grades one, two, and three, and in the total group, between sex and achievement in word identification, spelling, PS identification, and PS construction.

This hypothesis was analyzed by means of the Pearson Product Moment correlation, calculated by utilization of the DESTO2 IBM360 computer programme.

The correlations between sex and achievement on each of the four tests are presented in Table IV. No significant difference between boys and girls was found on test scores in the total group nor in each of the three grades. Girls and boys were combined, consequently, for all remaining data analyses.

TABLE IV

CORRELATIONS BETWEEN SEX AND TEST SCORES ACROSS GRADE LEVELS

Tests	Gr. 1	Gr. 2	Gr. 3	Total
IW[1.]	-.05	-.30	.24	.07
Sp[2.]	.03	-.05	.29	.03
IPS[3.]	.30	-.02	.27	.13
CPS[4.]	.24	-.02	.33	.12

*Significant at the .05 level
**Significant at the .01 level
1. Word identification; 2. Spelling; 3. PS identification
4. PS construction

Hypothesis Two

> There is no significant correlation on test scores in each of grades one, two, and three, and in the total group between:
>
> (a) word identification and spelling,
> (b) word identification and PS identification,
> (c) spelling and PS construction, and
> (d) PS identification and PS construction.

This hypothesis was analyzed by means of the Pearson Product Moment correlation and calculated by utilization of the DESTO2 IBM360 computer programme. Correlations between the tests are presented in Table V.

TABLE V

CORRELATIONS BETWEEN THE TEST SCORES ACROSS GRADE LEVELS

Correlates	Gr. 1	Gr. 2	Gr. 3	Total
WI[1.] and Sp[2]	.91**	.67**	.90**	.94**
WI and IPS[3.]	.53**	.67**	.67**	.75**
WI and CPS[4.]	.49**	.55**	.50**	.67**
Sp and CPS	.49**	.65**	.59**	.73**
Sp and IPS	.60**	.75**	.70**	.78**
IPS and CPS	.65**	.49**	.72**	.69**

**significant at the .01 level
1. Word identification; 2. Spelling; 3. PS identification;
4. PS construction

All tests of the various reading and writing skills show a strong relationship with each other (significant at the .01 level) for all grade levels and for the total group. Word identification and spelling showed the highest correlation (significant at the .001 level) in the total group. The correlations between achievement in spelling, word identification, and selection of PS appeared to fluctuate from grade to grade. Therefore there appeared to be no obvious developmental trend over the grades in the correlation of these scores.

The investigator questioned whether a relationship existed between the two decoding skills, word identification and PS identification, tested in this study. As indicated by Table V, the correlation between word identification (WI) and PS identification (IPS) was significant at the .01 level. Similarly, a significant relationship was found between constructing words, i.e., spelling (Sp), and constructing PS (CPS). It appeared, therefore, that skill in decoding words and in decoding PS was related; and that skill in encoding words (spelling) and in encoding PS was related.

The high correlation between word identification and spelling (WI and Sp) showed that skills in encoding and decoding words are related. Similarly, the correlation between identifying and constructing PS (IPS and CPS) indicated that skills in encoding and decoding PS are related.

The suggested possible four-way relationship between skills of word identification, spelling, PS identification, and PS construction was shown in Figure I (Chapter 3). This relationship, as shown by correlations of test results in Table V was found to be significant at the .01 level.

Cross-relationships were also discovered in analyzing the data. Figure II diagrammatically represents these cross-relationships, which may be summarized from Table V. A significant relationship was found between identifying words and constructing PS (WI and CPS) and between spelling and identifying PS (Sp and IPS).

There appeared to be an inter-relationship among word identification, spelling, PS identification, and PS construction. Decoding and encoding achievement seemed to be related. Achievement on the tests of coding words seemed to be related, and achievement on the test of coding PS seemed to be related. Furthermore, achievement in decoding words and encoding PS was significantly related, as was achievement in encoding words and decoding PS (Figure II).

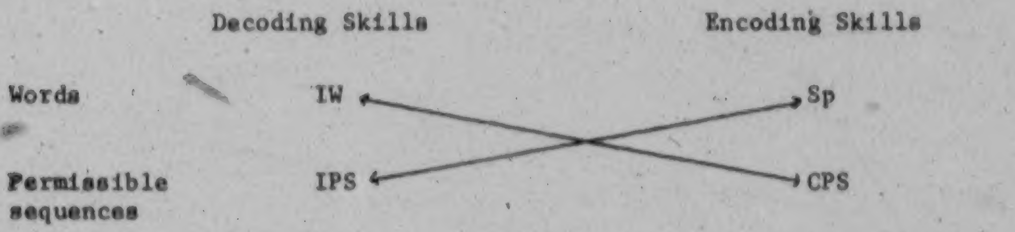

Figure 2. Cross-Relationships Between the Four Tests

Hypothesis Three

> There is no significant difference between achievement in grade one, grade two, and grade three in word identification, spelling, PS identification, and PS construction.

To test this hypothesis, the means and standard deviations of the subjects' scores on each of the four tests were found. The ANOV15 IBM 360 computer programme was used to determine if a difference existed between the three grades on each of the tests. A Scheffé test of Multiple Comparison of Means was applied to the data to determine the significance of the difference between the mean scores of the grades. The mean scores of the three grades and the differences between these scores will be discussed for each of the four skills, along with the behaviour of the students observed during the testing sessions.

Student performance in word identification. The children's behaviour during the administration of this test was observed. Some of the children, having correctly pronounced a series of words, made comments indicating that they were unfamiliar with them (e.g., "Hey, I don't even know what half these words mean!"). These words nonetheless were given credit as this test measured word pronunciation, not word understanding. Many of the children seemed to sound out the word to themselves in a whisper. Then, in many instances, after modifying or correcting the stress of the syllables and/or some of the sounds within the word, they synthesized the sounds and pronounced the word aloud. In these instances, vowels appeared to be modified more often than consonants. In mispronounced words also, the errors were greater for vowels than for consonants.

The mean scores, standard deviations, and standardized norms of word identification achievement as measured by the Slosson Oral Reading Test are presented in Table VI. Pupils in all grades appeared to have achieved well above the standardized scores for their level, although a wide range of achievement amongst the students was evident from the rather large standard deviations at each of the grade levels. The greatest increase in achievement on this test appeared to come between grades one and two (2.51 years). Additional improvement in word identification was also evident from grades two to three.

TABLE VI

STUDENT PERFORMANCE IN WORD IDENTIFICATION

Grade	N	Mean Grade Achievement	Standard Deviation	Standardized Norms
1	30	2.83	1.24	1.70
2	30	5.34	1.69	2.70
3	30	5.96	1.38	3.70

Application of a one-way analysis of variance to the data (Table VII) indicates that there was a significant difference ($p<.01$) between the mean scores of the grades. Table VIII indicates that this significant difference occurred between grades one and two, and between grades one and three. There was no significant difference between grades two and three word identification scores.

TABLE VII

ANALYSIS OF VARIANCE IN WORD IDENTIFICATION

Source of Variance	Sum of Squares	Variance Estimate	DF	F
Among means of total scores	16494.06	8247.03	2	32.25**
Within scores	18280.50	210.12	87	

**Significant at the .01 level

TABLE VIII

THE SCHEFFÉ COMPARISON OF MEANS ON WORD IDENTIFICATION SCORES ACROSS GRADES

Grade	1	2	3
1	1.000	.000**	.000**
2		1.000	.263

**Significant at the .01 level

Student performance in spelling. The children's behaviour during the administration of this test was observed. Many students in grade one seemed to sound out the words in a whisper as they wrote them. This pattern of behaviour was observed to a lesser degree in grade two students and only in a few cases with grade three children.

The mean scores, standard deviations, and standardized norms for spelling achievement are presented in Table IX. Again the mean students' score at each grade level was above the standardized norm for that grade. The greater inter-grade improvement in mean scores in spelling was 1.83 years, occurring between grades one and two. Further improvement though not as great was evidenced between grades two and three.

TABLE IX

STUDENT PERFORMANCE IN SPELLING

Grade	N	Mean Grade Achievement	Standard Deviation	Standardized Norms
1	30	2.21	.66	1.70
2	30	4.04	1.06	2.70
3	30	4.65	.96	3.70

Table X indicates that there was a significant difference ($p<.01$) between the mean grade scores of the spelling test. This difference (significant at the .01 level) occurred between grade one and grade two, and between grade one and grade three, as shown in Table XI. A less significant difference ($p<.05$) also occurred between grade two and grade three.

TABLE X

ANALYSIS OF VARIANCE IN SPELLING SCORES

Source of Variance	Sum of Squares	Variance Estimates	DF	F
Among means of total scores	9686.81	4843.41	2	58.4**
Within scores	7209.19	82.86	87	

**Significant at the .01 level

TABLE XI

THE SCHEFFÉ COMPARISON OF MEANS ON SPELLING SCORES ACROSS GRADE

Grade	1	2	3
1	1.000	.000**	.000**
2		1.000	.036*

*Significant at the .05 level
**Significant at the .01 level

Student performance in identification of PS. The children's behaviour was observed during this test which required them to circle the PS and to cross out the NPS. Students attempted to sound out the sequences in a whisper. This tendency appeared most markedly in the grade one children and least markedly in those in grade three.

Table XII presents the mean scores, standard deviations, and mean percentages of correct answers of each of the grade levels and of the total group as measured by the Test of Orthographic Structure. The score on this test represents the ability of students to differentiate PS from NPS when identifying pseudo-words. Of the three sequences per item, the students were required to identify the NPS and one of the two PS. Either of these two PS, one of which was of a higher frequency and one of which was of a lower frequency, was acceptable. Children who correctly identified one of the two PS but who selected the other PS in lieu of the NPS were assumed to be unable to differentiate PS from NPS for that item. Thus ability to identify the NPS in each item was necessary for that item to be considered correct.

TABLE XII

STUDENT PERFORMANCE IN IDENTIFICATION OF PERMISSIBLE SEQUENCES

Grade	N	Mean Score	Standard Deviation	Mean % Correct
1	30	8.17	3.69	54.4
2	30	11.90	2.84	79.3
3	30	12.97	2.16	86.4
1, 2,& 3	90	11.01	3.57	73.4

The results indicated that grade one children were correctly able to differentiate PS from NPS in slightly more than half the items; grade two children in approximately three-quarters of the items; and grade three children in approximately nine-tenths of the items. There appeared to be a developmental improvement from grade one to grade three in ability to identify PS from NPS. By the end of April of their first year at school, children could identify some of the acceptable patterns of English orthography. There was greater improvement between grades one and two than between grades two and three. Thus the amount of improvement decreased with ascending grade level.

An analysis of variance applied to the PS identification revealed a significant difference ($p<.01$) between the mean grade scores as presented in Table XIII. Table XIV indicated that this difference (significant at the .01 level) occurred between grades one and two and between grades one and three. No significant difference occurred between grades two and three. These results indicated that improvement between grades one and two is significant while between grades two and three it is not.

TABLE XIII

ANALYSIS OF VARIANCE IN IDENTIFICATION OF PERMISSIBLE SEQUENCE SCORES

Source of Variance	Sum of Squares	Variance Estimates	DF	F
Among means of total scores	381.15	190.58	2	21.65**
Within scores	765.84	8.80	87	

**Significant at the .01 level

TABLE XIV

THE SCHEFFÉ COMPARISON OF MEANS ON IDENTIFICATION OF PERMISSIBLE SEQUENCE SCORES ACROSS GRADES

Grade	1	2	3
1	1.000	.000**	.000**
2		1.000	.383

**Significant at the .01 level

Student performance in construction of PS. On this test children also attempted to sound out the pseudo-words in a whisper. As in the test measuring PS identification, the amount of whispering seemed to decrease with grade.

Table XV presents the mean scores, standard deviations, and mean percentages of correct answers of each of the grade levels, and of the total group, as measured by the Test of Letter Familiarity. The scores on this test represented the ability of students to differentiate permissible from non-permissible sequences when constructing pseudo-words. Correct answers were determined in precisely the same manner as they were for the test measuring PS identification.

TABLE XV

STUDENT PERFORMANCE IN CONSTRUCTION OF PERMISSIBLE SEQUENCES

Grade	N	Mean Score	Standard Deviation	Mean % Correct
1	30	8.93	2.27	44.1
2	30	11.87	3.63	59.3
3	30	13.20	2.96	66.0
1, 2, & 3	90	11.33	3.45	56.6

The results indicated that this test was more difficult for the students than was the test measuring PS identification. The mean percentages of correct answers were consistently lower at each grade level for PS construction than for PS identification--10% at the grade one level, and 20% lower at both the grade two and grade three levels. The total score for PS construction was 17% lower than the total scores for PS identification.

A gradual increase in mean scores, however, indicated a developmental improvement from grade one to grade three in constructing PS. By the end of April, the pupils in their first year of school were able to construct 44% of the letter sequences according to the rules of English orthography. By April of their second school year, students were able to construct approximately 60% of the sequences correctly. There was greater improvement between grades one and two than between grades two and three. By April of their third school year the children were correctly able to construct PS and NPS on two-thirds of the items.

To determine whether this improvement over the three years was significant, an analysis of variance was carried out. The results of this analysis are presented in Table XVI and showed that there was a significant difference ($p<.01$) between the mean scores. Table XVII indicated significant differences ($p<.01$) between grades one and two and between grades one and three. No significant difference occurred between grades two and three.

TABLE XVI

ANALYSIS OF VARIANCE IN CONSTRUCTION OF PERMISSIBLE SEQUENCE SCORES

Source of Variance	Sum of Squares	Variance Estimates	DF	F
Among means of total scores	285.86	142.93	2	15.82**
Within scores	786.14	9.04	87	

**Significant at the .01 level

TABLE XVII

THE SCHEFFÉ COMPARISON OF MEANS ON CONSTRUCTION OF PERMISSIBLE SEQUENCES ACROSS GRADES

Grade	1	2	3
1	1.000	.001**	.000**
2		1.000	.273

**Significant at the .01 level

Hypothesis Four

> There is no significant difference between grade one, grade two, and grade three in their scores of high-frequency and low-frequency sequences.

To test this hypothesis, the means and standard deviations of the subjects' scores of low-frequency and high-frequency sequences were calculated for the tests measuring identification of and construction of PS. The ANOV15 IBM 360 computer programme was used to determine if a difference existed between the three grades in each of these scores. A Scheffé test of Multiple Comparison of Means was applied to the data to determine the significance of the difference between the mean scores of the grades. Results of these analyses will be discussed in relation to each of the two tests.

PS identification. On the Test of Orthographic Structure the children were to identify one of three pseudo-words in each item as being a PS. Of these three, two were PS, one of a high frequency and one of a low frequency. Either the high-frequency PS or the low-frequency PS was acceptable.

A breakdown of the scores determined the number of high- and low-frequency sequences chosen at each grade level. These mean scores and their standard deviations are presented in Table XVIII. The percentage of high-frequency and low-frequency responses chosen in relation to the total PS score is also presented in the same table.

The mean score of all subjects showed a difference between the number of each response type chosen. Out of the total number of correct items, the children chose high-frequency sequences in more than 60% of the items at all grade levels. This indicated a preference in identifying high-frequency as opposed to low-frequency sequences.

TABLE XVIII

STUDENT PERFORMANCE IN IDENTIFICATION OF PERMISSIBLE SEQUENCES TYPES OF RESPONSES

Grade	A-High-Frequency			B-Low-Frequency			C-Total Correct		
	Mean Score	S. Dev.	% ($\overline{X}A/\overline{X}C$)	Mean Score	S. Dev.	% ($\overline{X}B/\overline{X}C$)	Mean Score	S. Dev.	% ($\overline{X}C/\overline{X}C$)
1	5.73	3.00	70.1	2.43	1.52	29.7	8.17	3.69	100
2	7.57	2.63	63.7	4.33	2.37	36.4	11.90	2.84	100
3	7.53	2.25	58.1	5.43	1.98	41.2	12.97	2.16	100
1,2, & 3	6.99	2.74	63.0	4.07	2.31	37.0	11.01	3.57	100

It was noted that the total mean score for PS showed an improvement at each grade level (Hypothesis Three, Table XII). An increase of mean scores over grades was also evident for low-frequency responses. The mean number of high-frequency responses was inconsistent with this trend, however, as scores showed an increase from grade one to grade two, but a decrease from grade two to grade three. To clarify this apparent inconsistency, the percentages of each frequency type (with relation to the total score) were examined. The percentage of low-frequency responses chosen was shown to increase with ascending grade. The percentage of high-frequency responses conversely decreased with ascending grade. This explained the reason for the drop in mean high-frequency scores found at the grade three level. These results indicated the presence of a tendency of children from grades one to three to increasingly identify low-frequency sequences.

An analysis of variance was applied to the data to determine if the differences between the mean grade scores was significant. The results of this analysis are presented in Table XIX and indicated a significant difference between the grades for high-frequency responses (p<.05) and for the low-frequency responses (p<.01).

TABLE XIX

ANALYSIS OF VARIANCE IN IDENTIFICATION OF PERMISSIBLE SEQUENCES
TYPES OF RESPONSES

Response Type	Source of Variance	Sum of Squares	Variance Estimates	DF	F
High-Frequency	Among means of total scores	66.02	33.01	2	4.70*
	Within scores	610.70	7.02	87	
Low-Frequency	Among means of total scores	138.20	69.10	2	17.51**
	Within scores	343.40	3.95	87	

*Significant at .05 level
**Significant at .01 level

Table XX indicated that significant differences occurred between grades one and two and between one and three for high-frequency responses

$(p<.05)$ and for low-frequency responses $(p<.01)$. No significant difference between grades two and three was evidenced.

TABLE XX

THE SCHEFFÉ COMPARISON OF MEANS IN IDENTIFICATION OF PERMISSIBLE SEQUENCES, TYPES OF RESPONSES

Grade		2	3
1	high-frequency	.032*	.036*
	low-frequency	.002**	.000**
2	high-frequency		.999
	low-frequency		.106

*Significant at the .05 level
**Significant at the .01 level

PS construction. On the Test of Letter Familiarity students were required to choose one of three letters to complete a letter sequence. Two of the three letters, properly inserted, would construct a PS, one a high-frequency PS and one a low-frequency PS. (Either of these two letters was acceptable.) The third letter, when inserted, would construct an NPS.

A breakdown of the scores determined the number of high- and low-frequency sequences constructed at each grade level. These mean scores, standard deviations, and the percentage of the mean total score that they represent are presented in Table XXI.

TABLE XXI

STUDENT PERFORMANCE IN CONSTRUCTION OF PERMISSIBLE SEQUENCES TYPES OF RESPONSES

Grade	A-High-Frequency			B-Low-Frequency			C-Total Correct		
	Mean Score	S. Dev.	% $(\bar{X}A/\bar{X}C)$	Mean Score	S. Dev.	% $(\bar{X}B/\bar{X}C$	Mean Score	S. Dev.	% $(\bar{X}C/\bar{X}C$
1	5.33	2.15	59.7	3.60	1.81	40.3	8.93	2.27	100
2	6.10	2.55	51.4	5.77	2.34	48.6	11.87	3.63	100
3	7.13	2.66	54.0	6.07	2.27	46.0	13.20	2.96	100
1, 2 & 3	6.19	2.53	54.6	5.14	2.39	45.3	11.33	3.45	100

The mean scores for all grades combined showed a difference between the number of each response type chosen, in favour of high-frequency sequences. Scores for each grade ranged from 50% to 60% of the total score for high-frequency responses, and from 40% to 50% of the total score for low-frequency responses. Thus there appeared to be a preference to select high-frequency sequences in constructing PS, but to a lesser degree than was evidenced in identifying PS (Table XVIII).

It was noted that the total mean score for PS constructed showed an improvement at each grade level (Table XV). An increase of mean scores with ascending grade was also evident for both the high-frequency and low-frequency responses (Table XXI). The pattern of development was not completely regular, however, as indicated by the actual percentage of high- and low-frequency responses out of the total responses. High-frequency mean percentages decreased from grades one to two but increased from grades two to three. Conversely, low-frequency percentages increased from grades one to two but decreased from grades two to three. The tendency to select more low-frequency sequences with grade, noted in identification of PS, was therefore evidenced only between grades one and two in the construction of PS.

An analysis of variance (Table XXII) revealed that significant differences existed between the grades for both high-frequency mean scores (P<.05) and low-frequency mean scores (p<.01). It was determined

TABLE XXII

ANALYSIS OF VARIANCE IN CONSTRUCTION OF PERMISSIBLE SEQUENCES TYPES OF RESPONSES

Response Type	Source of Variance	Sum of Squares	Variance Estimates	DF	F
High-Frequency	Among means of total scores	48.95	24.48	2	4.03*
	Within scores	528.83	6.08	87	
Low-Frequency	Among means of total scores	108.69	54.34	2	11.69**
	Within scores	404.43	4.65	87	

*Significant at the .05 level
**Significant at the .01 level

(Table XXIII) that these differences occurred only between grades one and three for high-frequency responses (p<.05). For low-frequency responses a significant difference (p<.01) was evidenced both between grades one and three and between grades one and two, but not between grades two and three.

TABLE XXIII

THE SCHEFFÉ COMPARISON OF MEANS IN CONSTRUCTION OF PERMISSIBLE SEQUENCES, TYPES OF RESPONSES

Grade		2	3
1	high-frequency	.487	.022*
	low-frequency	.001**	.000**
2	high-frequency		.2731
	low-frequency		.8651

*Significant at the .05 level
**Significant at the .01 level

Although not consistent, these results indicated that a trend existed in both identifying and constructing PS. Children chose more high-frequency responses than low-frequency responses, but the number of low-frequency responses increased with ascending grade.

Hypothesis Five

> There is no significant difference between scores of top achievers and bottom achievers of each grade and of the total group in their selection of high-frequency or

low-frequency sequences.

As there appeared to be an increasing tendency to select low-frequency responses in all grades in PS identification and from grades one to two and grades one to three in PS construction (Tables XVIII, XXI), the basis for this preference was examined in the light of achievement. Top and bottom achievers (see DEFINITION OF TERMS, Chapter I) were selected on the basis of achievement in the tests measuring:

(a) word identification,

(b) spelling,

(c) identification of PS, and

(d) construction of PS.

Using the computer Sort technique, the top third and the bottom third of the scores on each test were selected. This resulted in lists containing the top 10 scores in each test and the lowest 10 scores in each test, for each of the three grades. It also resulted in lists containing the top 30 scores in each test and the lowest 30 scores in each test out of the total group of 90 students. Scores of the top and bottom achievers were compared to determine whether there existed a difference in their selection of high- or low- frequency PS. The hypothesis was tested by an analysis of variance using the ANOV10 IBM computer programme.

In order to determine the selection preference of low- or high-frequency PS, four new scores were created for each subject from the original test scores. These scores represent the following ratios:

(a) the ratio of high-frequency PS to the total score in PS identification. (This score is represented in the tables by HI/TI),

(b) the ratio of low-frequency PS to the total score in PS identification (LI/TI),

(c) the ratio of high-frequency PS to the total score in PS construction (HC/TC), and

(d) the ratio of low-frequency PS to the total score in PS construction (LC/TC).

Mean scores were determined for each of the bottom achieving groups and each of the top achieving groups.

The top achievers and bottom achievers of the total group were examined first as their scores represented the greatest difference between top and bottom achievers. T tests were applied to the data to determine the difference between the means of these independent samples. As there were no preconceived expectations of the direction of the results, the significance was determined by a two-tailed test of probability rather than by a one-tailed test.

The mean scores, standard deviations, and probability for the top and bottom word identification achievers from the total group are presented in Table XXIV. The results revealed no significant difference between the two groups' selection of sequence frequency. Top achievers in word identification apparently did not identify significantly more nor less high-frequency sequences, nor significantly more nor less low-frequency sequences than bottom achievers. Nor was the top achievers' frequency choice in constructing PS significantly different from bottom achievers.

TABLE XXIV

FREQUENCY PREFERENCE OF TOP AND BOTTOM ACHIEVERS BASED ON WORD IDENTIFICATION

Ratio	Top Achievers		Bottom Achievers		DF	Probability
	Mean	S. Dev.	Mean	S. Dev.		
HI/TI	.59	.19	.66	.19	58	.138
LI/TI	.41	.19	.34	.19	58	.138
HC/TC	.54	.13	.58	.19	58	.380
LC/TC	.46	.13	.42	.19	58	.380

*Significant at the .05 level
**Significant at the .01 level

In a similar manner, the frequency choice of the total group's top and bottom achievers in spelling was examined. The mean scores, standard deviation, and probability for the two groups is presented in Table XXV. The results revealed no significant difference between the top and bottom achievers in their frequency preference when identifying and constructing PS.

TABLE XXV

FREQUENCY PREFERENCE OF TOP AND BOTTOM ACHIEVERS BASED ON SPELLING

Ratio	Top Achievers		Bottom Achievers		DF	Probability
	Mean	S. Dev.	Mean	S. Dev.		
HI/TI	.61	.15	.66	.19	58	.254
LI/TI	.39	.15	.34	.19	58	.254
HC/TC	.51	.15	.56	.18	58	.223
LC/TC	.49	.15	.44	.18	58	.223

*Significant at the .05 level
**Significant at the .01 level

The total group's top and bottom achievers in PS identification was examined next. The mean scores, standard deviations, and probabilities of their frequency selections are presented in Table XXVI. Results indicated that no significant difference existed between the two groups' selection of sequence frequency.

TABLE XXVI

FREQUENCY PREFERENCE OF TOP AND BOTTOM ACHIEVERS BASED ON IDENTIFICATION OF PERMISSIBLE SEQUENCES

Ratio	Top Achievers		Bottom Achievers		DF	Probability
	Mean	S. Dev.	Mean	S. Dev.		
HI/TI	.63	.13	.67	.21	58	.322
LI/TI	.37	.13	.33	.21	58	.322
HC/TC	.52	.13	.55	.20	58	.519
LC/TC	.48	.13	.45	.20	58	.519

*Significant at the .05 level
**Significant at the .01 level

Finally, the total group's top and bottom achievers in PS construction was examined. The mean scores, standard deviations, and probabilities of their frequency selection are presented in Table XXVII. No significant difference existed between top achievers' and bottom achievers' selection of sequence frequency.

Therefore, top achievers and bottom achievers of the total group did not differ significantly in their preference of high- or low-frequency sequences. Mean scores in all four tables (Table XXIV, Table XXV, Table XXVI, and Table XXVII), however, indicated that top achievers consistently selected more low frequency sequences than bottom achievers, in relation to total score, and bottom achievers consistently selected more high frequency sequences.

TABLE XXVII

FREQUENCY PREFERENCE OF TOP AND BOTTOM ACHIEVERS BASED ON CONSTRUCTION OF PERMISSIBLE SEQUENCES

Ratio	Top Achievers		Bottom Achievers		DF	Probability
	Mean	S. Dev.	Mean	S. Dev.		
HI/TI	.62	.15	.64	.18	58	.610
LI/TI	.38	.15	.36	.18	58	.610
HC/TC	.54	.14	.56	.17	58	.541
LC/TC	.46	.14	.44	.17	58	.541

*Significant at the .05 level

**Significant at the .01 level

Top achievers and bottom achievers of each grade were also examined in exactly the same manner as were top and bottom achievers of the total group. Achievers were defined first with respect to word identification, then spelling, PS identification, and PS construction. In each case there was no significant difference in their frequency preference. As the data are similar to those for the whole group, they will not be presented here.

II. SUMMARY OF THE RESULTS

The areas in which achievement were measured were:

(a) word identification,

(b) spelling,

(c) identification of PS, and

(d) construction of PS.

Significant correlations between the four tests were revealed. The correlation between achievement in word identification and reading was found to be the highest of all the correlations. Results indicated that an inter-relationship among all four tests was present.

The three grades were compared with respect to their scores of word identification, spelling, PS identification, and PS construction. A significant difference was found between grades one and two and between grades one and three on all four measures. No significant difference occurred between grade two and grade three except on the spelling measure. An increase in achievement with ascending grade was evidenced on all measures. The amount of improvement between each grade, however, decreased with ascending grade.

The three grades were compared with respect to their high-frequency and low-frequency scores on the measures of PS identification and PS construction. Significant differences were found between grades one and two and between grades one and three in the number of high-frequency sequences identified, the number of low-frequency sequences identified, and the number of low-frequency sequences constructed. A significant difference between grades one and three, but not between grades one and two, was found in scores of high-frequency sequences constructed. No significant difference between grade two and grade three frequency scores was found either in identifying or in constructing PS. The total group of children identified high-frequency as opposed to low-frequency sequences in 60% of the items and constructed high-frequency as opposed to low-frequency sequences on 55% of the items. Results thus suggested an overall preference to select high-frequency sequences, which diminished with ascending grade level.

Top achievers and bottom achievers were selected from scores on measures of word identification, spelling, PS identification, and PS construction. The two resulting groups were compared with respect to their relative selection of high- and low-frequency responses. Top achievers and bottom achievers showed no significant difference in their selection of high- or low-frequency responses when identifying nor when constructing PS. This non-significant difference occurred when top and bottom achievers were selected from the whole group as well as when they were selected at each grade level. It was noted that although the difference was not significant, top achievers consistently selected more low-frequency sequences than bottom achievers and bottom achievers selected more high-frequency sequences than top achievers.

III. ADDITIONAL FINDINGS

Scoring Methods

Heck (1972) found only a low correlation between reading achievement and awareness of PS. It was suggested (Chapter 2) that part of the reason for his not finding a stronger relationship might have been due to his method of scoring. Of the three pseudo-words presented in each item, two were PS, and one NPS. Heck scored as correct all items in which one PS was selected, regardless of whether the child was able to identify or construct the NPS. It is held that this method of scoring did not measure children's ability to differentiate PS from NPS. By chance alone, subjects would receive credit for 66.6% of each of these tests in identifying and constructing PS. Heck's report that children found little difficulty in selecting PS, then, is hardly surprising. Their ability to identify and to construct PS as measured by results of the present study, however, indicated that the task was more difficult.

The method of scoring used in this study required that children show ability to differentiate between the PS and NPS. That is, a PS as well as an NPS had to be indicated for the child to receive credit for that item.

A comparison of this revised method of scoring with Heck's method was carried out. The two methods of scoring were applied to the data of this study. A comparison of the test correlations determined by the Pearson Product Moment technique are presented in Table XXVIII. Seventeen of the 20 correlations were higher when scored by the revised method as opposed to that used by Heck. Two of the correlations which are non-significant using Heck's method, are significant at the .01 level using the revised method.

TABLE XXVIII

CORRELATIONS OF THE FOUR TESTS USING TWO SCORING METHODS

Correlates	Gr. 1		Gr. 2		Gr. 3		Total	
	Heck	Revised	Heck	Revised	Heck	Revised	Heck	Revised
WI[1] and IPS[2]	.42*	.53**	.46*	.67**	.39	.67**	.58**	.75**
WI and CPS[3]	.58**	.49**	.39*	.55**	.36	.50**	.56**	.67**
Sp[4] and CPS	.65**	.49**	.56**	.65**	.46*	.59**	.62**	.73**
Sp and IPS	.60**	.60**	.58**	.75**	.42*	.70**	.63**	.78**
IPS and CPS	.47**	.65**	.52**	.49**	.55**	.72**	.57**	.69**

*Significant at the .05 level
**Significant at the .01 level

1. Word identification; 2. PS identification; 3. PS construction; 4. Spelling

Table XXIX presents the means of the tests measuring the identification of and construction of PS. The results are those of the subjects used in this study but scoring was done once using Heck's method and once using the revised method. Using Heck's method, the subjects would have received relatively high scores (almost 100% accuracy in mean PS identification scores for grades two and three) as compared to the revised method. The revised method showed a more obvious pattern of improvement.

TABLE XXIX

COMPARISON OF MEANS OF THE TESTS OF IDENTIFICATION AND CONSTRUCTION OF PERMISSIBLE SEQUENCES USING TWO METHODS OF SCORING

		Total Score	Mean Scores (Heck)	Mean Scores (Revised)
IPS[1]	Gr. 1	15	12.6	8.2
	Gr. 2	15	14.2	11.9
	Gr. 3	15	14.6	13.0
CPS[2]	Gr. 1	20	15.6	8.9
	Gr. 2	20	17.4	11.9
	Gr. 3	20	17.6	13.2

1. PS identification; 2. PS construction

The difference between Heck's actual results (using his subjects) and the results of the present research may now be examined in light of the different scoring methods used. Table XXX presents the mean scores for the tests of PS identification and PS construction from the two studies. Heck used subjects in grades two, three, and four, whereas this study investigated the same ability in grades one, two, and three. Only grades examined in both studies (grades two and three) are compared. Similar differences between the results of the two grades were noted, as was found between the two methods of scoring used in the present study. The mean scores in Heck's study are higher, but the growth is apparent between the grades in both studies.

TABLE XXX

COMPARISON OF MEANS FROM HECK AND FROM THIS STUDY
IN TESTS OF PERMISSIBLE SEQUENCE
IDENTIFICATION & CONSTRUCTION

		Mean Scores (Heck)	Mean Scores (This study)
IPS[1.]	Gr. 2	13.7	11.9
	Gr. 3	14.4	13.0
CPS[2.]	Gr. 2	14.5	11.9
	Gr. 3	16.2	13.2

1. PS identification; 2. PS construction

As noted in the correlations and in the comparison of means using the different scoring methods outlined, different results would have occurred had Heck's rather than the revised method been used.

CHAPTER V

SUMMARY, MAIN FINDINGS AND CONCLUSIONS, IMPLICATIONS, AND SUGGESTIONS FOR FURTHER RESEARCH

I. SUMMARY

This study investigated the inter-relationship between achievement in word identification, in spelling, and in differentiating permissible sequences (PS) from non-permissible sequences (NPS).

A sample of thirty children from each of grades one, two, and three was randomly selected from a designated school in the Edmonton Public School System. Each of the ninety children was tested invididually on the Slosson Oral Reading Test measuring skill in identifying words (Appendix A). The following three tests were administered to each grade:

(a) the Graded Word Spelling Test (Schonell) (Appendix B),

(b) the Test of Orthographic Structure, designed by Heck (1972) to measure ability to identify PS and NPS (Appendix C), and

(c) the Test of Letter Familiarity, designed by Heck to measure ability to construct PS and NPS (Appendix D).

The teachers of the subjects were interviewed individually and completed a questionnaire in order to assess the language arts programme. All research was conducted during a two-week period in April.

The tests were hand-scored by the examiner, and the data analyzed and interpreted with respect to the five null hypotheses that had been formulated. Correlation coefficients were computed to assess the import of sex with respect to the tests, as well as to analyze the inter-relationships between the various tests. A one-way analysis of variance was applied to the data to determine if there was a significant difference between the grades in their scores of word identification, spelling, PS identification, PS construction, and high- and low-frequency sequence selection. Further analysis was carried out to determine the difference between top achievers and bottom achievers in their selection of high- and low-frequency sequences.

II. MAIN FINDINGS AND CONCLUSIONS

Hypothesis One

> There is no significant correlation in each of grades one, two, and three and in the total group, between sex and achievement in word identification, spelling, PS identification and PS construction.

As no significant correlation between the scores of the male subjects and the scores of the female subjects was found on any of the four measures, this hypothesis was accepted. This finding is at odds with much research carried out to investigate sex difference with respect to school achievement (Samuels, 1943; Gates, 1961). Possible reasons for this inconsistency are given here. Educators have been criticized for "feminizing" schools (Smith, 1973), that is, for favouring the female students. Perhaps the increase in male elementary teachers of recent years as well as teachers' gradual realization that boys prefer to read different types of books than girls, has changed boys' interest and hence achievement in reading. It was previously noted (Ch. 2), that reading is related to the other language abilities.

As the results of the non-significant correlation between sex and these tests are specific to this study, the explanation may be in the nature of the sample. Many of the subjects came from academically-oriented families, whose interest in their children's reading and language abilities might possibly be greater than the interest of those families who are not academically oriented. Furthermore, Sheldon, Nichols, and Lashinger (1967) found no difference in reading achievement when boys and girls of high ability were compared. If the sample was composed of high-ability children, their research would support the findings of this study. However, ability of the sample in relation to other populations was not determined in this study, although scores on the Slosson Oral Reading Test were higher for the sample than the normed scores.

Hypothesis Two

> There is no significant correlation on test scores in each of grades one, two and three, and in the total group between:
> (a) word identification and spelling
> (b) word identification and PS identification and
> (c) spelling and PS construction and
> (d) PS identification and PS construction.

This hypothesis was rejected on the grounds that all of the above correlations were highly significant ($p < .01$) for all grades and for the total group. It was concluded that a significant relationship existed between the decoding skills and the PS skills. Furthermore, significant correlations were also found between word identification and PS construction, and between spelling and PS identification. This indicated that each of the four measures (word identification, spelling, PS identification, and PS construction) was related to each of the other measures. None of the skills tested, then, appeared to be a totally separate skill. Nor are encoding nor decoding nor word skills nor PS skills discrete abilities, but are related.

These findings, of the inter-relationship between the various language skills tested, support the research quoted in Chapter II of this study, which indicated:

(a) a relationship between reading and spelling,
(b) a relationship between knowledge of orthographic structure and spelling achievement,
(c) a relationship between knowledge of orthographic structure and word perception, and
(d) a possible relationship between knowledge of orthographic structure and reading achievement.

Thus evidence points to a common factor in these skills. They each represent one aspect of language ability. However, a more specific casual relationship is plausible. It has been noted

(Gibson et al., 1962, 1963, 1965, 1970; Rosinski & Wheeler, 1972) that children acquire knowledge of grapheme-phoneme correspondence and letter patterns in English orthography. This study and that of Heck (1972) have indicated that this knowledge is transferred to the identification and the construction of pseudo-words. This generalizing ability of the arrangement of letters in English and of the phonemic correspondence of these groups of letters, may be the basis for ability in word identification and spelling.

Hypothesis Three

> There is no significant difference between achievement in grade one, grade two, and grade three in word identification, spelling, PS identification, and PS construction.

Statistically significant differences occurred on all measures between scores of grade one and scores of grade two, and between scores of grade one and scores of grade three. However, no significant difference was found between grade two scores and grade three scores except on the spelling measure. This hypothesis was therefore accepted only in part.

Scores of the abilities measured improved significantly from grades one to two, but not significantly from grades two to three, with the exception of spelling. The amount of improvement would appear to decrease, in general, with each succeeding grade. As testing was carried out in the latter part of the school year, the decreasing improvement in skills from grades two to three indicated that the "levelling-off" of improvement took place during the third school year. A great improvement on all four measures appeared to come between the end of grade one and the end of grade two. The difference between the beginning of grade one to the end of grade one might be equally great, but was not measured in this study. It appeared that somewhere in the second year of schooling, children acquired an ability:

(a) to recognize many words,

(b) to spell many words,

(c) to identify PS and NPS of English orthography and

(d) to construct PS and NPS of English orthography.

Many of the words pronounced correctly on the Slosson Oral Reading Test were reported by the children as being unfamiliar. Similarly, the pseudo-words identified and constructed as PS and NPS were also unfamiliar to the subjects. The increase at the grade two level therefore might indicate that the children had learned at this point in time to generalize many of the rules of orthography (permissible sequences) and of grapheme-phoneme correspondence. Increasing exposure to words in school might allow for an increasing ability to generalize these patterns. It would seem that children acquire awareness of these patterns relatively easily, as evidenced by their performance at the end of grade one.

Therefore, it is suggested that children acquire a certain facility in generalizing patterns of English orthographic structure in grade one (as noted by the PS tests results), which improves considerably in the next year. The third-grade "levelling-off" may be indicative of an optimal level, or cut-off point, in orthographic generalization having been reached by children at this stage. This suggestion is supported by the research of Rosinski and Wheeler (1972), who found a similar "levelling-off" of ability in extracting orthographic structure, at the grade three level. It was noted that spelling achievement did not appear to follow this levelling-off pattern between grades two and three. This might be due to less stress being placed on spelling and spelling patterns in the early stages of language arts instruction.

Another explanation is suggested for children's ability to pronounce words which were, reportedly, visually unfamiliar to them. Many of the children sounded out the word to themselves in a whisper before they said the word aloud. The researcher noted that the whispered word was often pronounced incorrectly, but that it was modified and then pronounced correctly aloud. In cases in which this occurred, the children appeared to have heard the word before, without necessarily knowing the meaning, and associated the letter patterns which they pronounced to themselves (partly correctly and partly incorrectly) with a remembered auditory pattern. Other children who pronounced words to themselves with an equal amount of correctness, were unable to associate the approximation of the word with any remembered auditory pattern. Perhaps, then, a wide exposure to different words is a significant variable in word identification achievement.

Hypothesis Four

> There is no significant difference between grade one, grade two, and grade three in their scores of high-frequency and low-frequency sequences.

This hypothesis was accepted in part on the grounds that no significant difference between grade two and grade three frequency scores was found either in identifying or in constructing PS. Significant differences were found between grades one and two and between grades one and three in the number of high-frequency sequences identified, the number of low-frequency sequences identified, and the number of low-frequency sequences constructed. A significant difference was also found between grades one and three, but not between grades one and two in scores of high-frequency sequences constructed. Save one disagreement, the results indicate a significant improvement from grade two to grade three in the number of high- and low-frequency responses chosen. As ability to recognize PS of any frequency increased in the same way, these results follow the same pattern.

However, the total group of children identified high-frequency sequences 60% of the time and constructed high-frequency sequences 55% of the time. This preference for high frequency sequences can be explained by the fact that high-frequency sequences should be more familiar to children as they occur more often in written language than do low-frequency sequences. The fact that the children chose the high-frequency sequences more often supported the results obtained by Biederman (1966). He found that for words of low frequency of occurrence, high digram frequency words were perceived more easily than low digram frequency words. One-third of the items on the PS tests were real words with such low-frequency of occurrence that they could be considered pseudo-words. The other items were pseudo-words, and therefore of zero-frequency of occurrence. This study showed, then that words of low-frequency of occurrence are identified and constructed more often when they have a high digram/trigram frequency count than when they have a low digram/trigram frequency count.

The percentage of high-frequency PS identified decreased with ascending grade level while the percentage of low-frequency PS identified increased with grade. These results indicated a tendency of the subjects to identify relatively more low-frequency PS with ascending grade. This tendency was noted in the construction of PS only from grade one to grade two. In constructing PS, the percentage of high-frequency PS decreased from grades one to two but increased from grades two to three. Conversely, the percentage of low-frequency PS increased from grades one to two but decreased from grades two to three.

The tendency to identify fewer high-frequency sequences with grade supports the research findings of Levin and Biemiller (1968). They concluded that children identified more easily words having a spelling pattern with which they were most familiar. Again, the high-frequency sequences, occurring more often in written language, should be the sequences most familiar to young children. It is postulated that as their familiarity with orthographic patterns grows, they become familiar with less common (low-frequency) sequences, and consequently differentiate less between them.

The same "levelling-off" patterns as was evidenced in the overall achievement of the four tests, is apparent with regard to frequency preference. For all grades, at least in PS identification, the number of high-frequency responses decreased, and the number of low-frequency responses increased with ascending grade. This also may be due to their increasing exposure to different types of letter sequences. In grade one, they may be either more aware of, or more familiar with, only the more common and therefore higher frequency sequences. By grade three, the children may have become familiar with the less common sequences as well. This may account for their choosing higher frequency sequences only slightly more than half the time. The possibility of a differential choice in high- and low-frequencies with grade level was suggested by these results. As achievement in all measures improved with grade level, it was thought that frequency preference might be related to achievement. For this reason the following hypothesis was formulated and statistically tested.

Hypothesis Five

> There is no significant difference between scores of top achievers and bottom achievers of each grade and of the total group in their selection of high-frequency or low-frequency sequences.

This hypothesis determined if top achievers chose more high- or low-frequency responses, with respect to their total score, than bottom achievers. Top achievers and bottom achievers were selected from scores on measures of word identification, spelling, PS identification, and PS construction. The two resulting groups were compared with respect to their relative selection of high and low-frequency responses. Top achievers and bottom achievers showed no significant difference in their selection of high- or low-frequency responses when identifying PS nor when constructing PS. This non-significant difference occurred when top and bottom achievers were selected from the whole group as well as when they were selected from each grade level, and were analyzed by grade. Hypothesis Five can therefore be accepted.

Although the difference was not significant, top achievers consistently selected more low-frequency sequences than bottom achievers, and bottom achievers selected consistently more high-frequency sequences than top achievers. Therefore, although results are not significant, there appears to be a difference in the preference of top and bottom achievers when selecting responses of differing frequencies.

This lack of significant difference may have been due to the manner in which the PS of differing frequencies had been selected (Heck, 1972). One of each pair of PS, it will be remembered, was a real word. The total digram and trigram count of this word was considered to be either highly frequent or of low frequency. This decision was relative to the frequency count of other digrams and/or trigrams beginning with the same letter. If the real word was considered to be of high frequency, then the distractor was made of letters of the lowest possible digram and trigram counts. If the real word was considered to be of low frequency, then the distractor was made of letters having the highest possible digram and trigram frequency counts. The real words chosen, however, were only of relatively high and relatively low digram/trigram frequency with respect to a 20,000 word list. The cut-off point for high and low frequencies was not indicated by Heck. It is possible, then that had the categories of high- and low - frequency PS been constructed so as to be more disparate, the results might have shown a significantly different preference between top and bottom achievers.

On the other hand, it may well be that choice of frequency is related to grade (as is shown in results of Hypothesis Four), but not to achievement. Results of this research indicate that frequency choice is related neither to achievement in written language, i.e., reading and spelling, nor to achievement in orthographic knowledge (PS).

Additional Findings

Scoring methods. Heck's (1972) finding of a low correlation between reading and PS skills was partly explained by his method of scoring. Items in which a PS was identified or constructed were given credit regardless of whether the NPS was also identified or constructed. It was postulated previously in this study that Heck's scoring method did not distinguish between those items in which ability to differentiate PS from NPS was indicated and those items in which it was not. A revised method of scoring, designed to measure the ability in each item to differentiate PS from NPS was utilized to obtain the present results. A comparison of the two methods of scoring was carried out on the data collected for this study. Results revealed that Heck's method yielded lower correlations between the four measures and relatively high scores on the PS tests (almost 100% accuracy in mean PS identification scores for grades two and three). The revised method showed a more obvious pattern of improvement from grade to grade.

III. IMPLICATIONS

This study has shown that there is a statistical correlation between children's ability in word identification, spelling, PS identification, and PS construction. Previous research (Gibson, 1965; Rosinski & Wheeler, 1972) has indicated that in the course of learning to read, children extract the rules of grapheme-phoneme correspondences and permissible letter patternings of English orthography. It is postulated (in the present study) that children generalize grapheme-phoneme correspondences and PS patterns to aid in the identification of words and in spelling. It is further postulated that knowledge of these two sets of rules, which is acquired in the early stages of reading, is the basis of the two skills of word identification and spelling. The present investigation therefore supports Gibson's (1965) suggestion that programmed reading materials could enhance the opportunities for discovering grapheme-phoneme correspondences, and extends this suggestion to include opportunities for discovering PS patterns. Such programming, also suggested by Heck (1972) would be based on the regularities in spelling and word patterns.

The present study indicated a high correlation between identifying words and spelling. Fries (1963) and Gibson (1965) suggest that the discovery and mastery of these rules might be enhanced if spelling were coordinated with reading. It might also be that spelling and reading would be enhanced if their instruction was coordinated with the mastery of correspondence rules and the rules of sequencing. Factors of redundancy or PS in English orthography might be included in both spelling and reading instruction. The probability or predictability of letter sequences might be incorporated in such instruction to develop an awareness of the sequential dependencies among letters of the English language. This awareness might then aid in identifying words and in spelling where the acquired knowledge could be transferred to new words.

A significant correlation between achievement in spelling and in identifying words was found with achievement in the tests measuring awareness of PS. Poorer achievers in spelling and identifying words might be aided by a programme emphasizing grapheme-phoneme correspondence and permissible sequencing of letters.

As ability in PS measures was regarded as the ability to generalize the intrinsic rules of English orthography, this ability to generalize linguistic information might be extended to include other language skills. Forming sentences, whether oral or written, involves the patterning and re-patterning of words and phrases. Sophistication in spoken and written language expression, if related to ability to generalize language patterns (as suggested by Goodman, 1963), might also be facilitated by instruction in language generalizations.

This study suggested that ability to identify words might be related to having an auditory memory pattern for that word. If this is the case, the number of words children have heard is of import to their learning to read fluently. It is suggested, therefore, that greater emphasis be placed on exposing children auditorily to a large vocabulary.

It was apparent that the pronunciation of vowels was more difficult than the pronunciation of consonants, in identifying words. It is therefore suggested that instruction place more emphasis on the various vowel pronunciations than is presently done.

IV. SUGGESTIONS FOR FURTHER RESEARCH

The following problems arise out of this study as areas for consideration as further research:

1. The second year of school appeared to be the period of greatest growth on PS skills measured, from which time improvement slowed down. However, by the end of first grade, children appeared to differentiate PS from NPS approximately 50% of the time. Research yielding results from testing children in kindergarten and

children at the beginning of first grade, might give evidence as to how much of this ability is actually learned in grade one and how much is acquired before entering school.

2. Differences in the performance of children might be further investigated with a study of the relationship between achievement in PS identification and construction and language variables other than word identification and spelling, such as verbal ability, written expression, phonics, and word memory.
3. As achievement in PS identification and construction is based on the ability to generalize linguistic patterns, other generalizing abilities either linguistic, mathematical, or logical might be correlated with ability on Heck's two tests.
4. There appeared to be an increase with ascending grade, in the number of low-frequency sequences identified by the subjects. As children become more fully acquainted with acceptable English orthographic patterns, they appear to identify a greater number of low-frequency sequences. Heck's (1972) tests might therefore be administered to children in the upper elementary grades to determine whether they identify a still greater number of low-frequency sequences. Similarly, adult readers might be administered Heck's tests to determine whether fluent readers who are fully cognizant of orthographic structure, choose low- or high-frequency items at chance level, or whether they, too, favour either one of the choices.

5. Criticism was levelled at Heck's construction of PS categories of high and low frequency. If new PS were constructed utilizing more disparate categories of high and low frequency, the preference tendency with ascending grade might be more clearly defined. Similarly, a more significant difference with regard to achievement and response preference of a high- or low-frequency might be found.
6. A pattern of decreasing amount of growth with ascending grade was noted in achievement in the tests administered in the present study. This developmental pattern of these skills as well as other school skills might be further investigated in a study of children from all elementary grades, using the same tests.
7. As results of this study are inconsistent with respect to much previous research (see Ch. 2) on the relationship between sex differences and school achievement, this relationship might be further investigated.
8. It was suggested in this study that children in pronouncing words appeared to associate tentative pronunciations with an auditory memory pattern of that word. An investigation might be conducted to determine the relationship between word memory and word identification, the relationship between auditory memory and word identification, and the relationship between oral vocabulary and word identification.
9. A wide exposure to different words was suggested as a significant variable with regard to word identification ability. This

relationship between children's verbal exposure and their achievement in various language abilities might be researched. In the investigation, however, each child's background experience would have to be examined, as well as factors such as his parents' occupation, his parents' education, oral communication in the home, peer group associates, and amount of time spent reading and watching television.

REFERENCES

REFERENCES

Alden, C. L., Sullivan, H., & Durrell, D. The frequency of special reading disabilities. *Education*, 1941, *62*, 32-36.

Amster, H., & Keppel, G. Letter sequence habits in children. *Journal of Verbal Learning and Verbal Behavior*, 1968, *7*, 326-332.

Anisfeld, M. A comment on "The role of grapheme-phoneme correspondence in the perception of words." *American Journal of Psychology*, 1964, *77*, 320-321.

Aukerman, R. C. *Approaches to beginning reading*. New York: John Wiley & Sons, 1971.

Ausubel, D. P. Cognitive structure: Learning to read. *Education*, 1967, *87*, 544-548.

Biederman, B. Supplementary report: The recognition of tachistoscopically presented five-letter words as a function of digram frequency. *Journal of Verbal Learning and Verbal Behavior*, 1966, *5*, 208-209.

Bishop, C. H. Transfer effects of word and letter training in reading. *Journal of Verbal Learning and Verbal Behavior*, 1964, *3*, 215-221.

Blishen, B. R. A socio-economic index for occupations in Canada. In B. Blishen et al. (Eds.). *Canadian society: Sociological perspectives* (3rd. ed.), Toronto: Macmillan, 1968.

Brandis, W., & Henderson, D. *Social class, language and communication*. London: Routledge & Kegan Paul, 1970.

Carroll, J. B., Davis, P., & Richman, B. *Word frequency book*. Boston: Houghton Mifflin, 1971.

Carson, D. H. Letter constraints within words in printed English. *Kybernetik*, 1961, *1*, 46-54.

Cattell, J. On the time required for recognizing and naming letters and words, pictures, and colours. *James McKeen Cattell. Man of Science*, Lancaster: Science Press, 1947.

Chalmers, J. W. A study of the effective and recognized vocabularies of Alberta students in grades seven to twelve. Unpublished masters thesis, University of Alberta, 1935.

Clark, W. W. Boys and girls - Are there significant ability and achievement differences? *Phi Delta Kappan*, 1959, *41*, 73-76.

Cramer, L. An investigation of the spelling achievement of two groups of first-grade classes on phonologically regular and irregular words and in written composition. Unpublished doctoral dissertation, University of Delaware, 1968.

Fay, L. Spelling and reading. How are they related? Washington: National Reading Center Foundation, 1971.

Feifel, J., & Lorge, W. Reliability by agreements and disagreements. Journal of Educational Psychology, 1950, 61, 1-18.

Fries, C. C. Linguistics and reading. New York: Holt, Rinehart & Winston, 1963.

Gaspar, R., & Brown, D. Perceptual processes in reading. London: Hutchinson Educational, 1973.

Gates, A. I. Sex differences in reading ability. Elementary School Journal, 1961, 61, 431-434.

Gibson, E. J. On the perception of words. American Journal of Psychology, 1964, 77, 667-668.

Gibson, E. J. Learning to read. Science, 1965, 148, 1066-1072.

Gibson, E. J. Principles of perceptual learning and development. New York: Appleton-Century-Crofts, 1969.

Gibson, E. J. The ontogeny of reading. American Psychologist, 1970, 25, 136-143.

Gibson, E. J., Bishop, C. H., Schiff, W., & Smith, J. Comparison of meaningfulness and pronounceability as grouping principles in the perception and retention of verbal material. Journal of Experimental Psychology, 1964, 67, 173-182.

Gibson, E. J., Pick, A. D., Osser, H., & Hammond, M. The role of grapheme-phoneme correspondences in the perception of words. American Journal of Psychology, 1962, 75, 554-570.

Gibson, E. J., Shurcliff, A., & Yonas, A. The role of pronounceability in the perception of pseudo-words by hearing and deaf subjects. In H. Levin, E. J. Gibson, & J. J. Gibson (Eds.), The analysis of reading skill: A program of basic and applied research. Washington: U. S. Department of Health, Education, and Welfare, 1968, 14-39.

Goodman, K. S. (Ed.). The psycholinguistic nature of the reading process. Detroit: Wayne State University Press, 1968.

Hall, R. A., Jr. *Introductory linguistics*. Philadelphia: Chilton, 1964.

Hanna, P. L., Hanna, J. S., Hodges, R. E., & Rudorf, E. H., Jr. *Phoneme-grapheme correspondences as cues to spelling improvement*. Washington: U. S. Department of Health, Education, and Welfare, 1966.

Hanna, P. R., & Hodges, R. E. Spelling and communications theory: A model and an annotated bibliography. Reprinted from *Elementary English*, May, 1963, by the National Council of Teachers of English.

Hanna, P. R., Hodges, R. E., & Hanna, J. S., *Spelling: Structure and strategies*. Boston: Houghton Mifflin, 1971.

Havighurst, R. J., & Neugarten, B. L. *Society and education*. Boston: Allyn & Bacon, 1967.

Heck, G. J. The relationship between reading achievement and awareness of English orthographic structure. Unpublished masters thesis, University of Alberta, 1972.

Helmstadter, G. C. *Research concepts in human behavior*. New York: Appleton-Century-Crofts, 1970.

Hockett, C. F. Analysis of English spelling. In H. Levin et al. (Eds.), *A basic research program on reading*. Ithaca; Cornell University, 1963.

Howes, D. H., & Solomon, R. L. Visual duration threshold as a function of word-probability. *Journal of Experimental Psychology*, 1951, *41*, 401-410.

Jeffrey, W. E., & Samuels, S. J. The effect of reading training on initial learning and transfer. *Journal of Verbal Learning and Verbal Behavior*, 1967, *6*, 354-358.

Kolers, P. A., & Katzman, M. T. Naming sequentially presented letters and words. Language and Speech, 1966, *9*, 84-95.

Kottmeyer, W., & Ware, K. *Basic spelling goals*. St. Louis, Mo.: Webster, 1960.

Lefevre, C. A. A multidisciplinary approach to language and to reading: Some projections. In K. S. Goodman (Ed.), *The psycholinguistic nature of the reading process*. Detroit: Wayne State University Press, 1968. Pp. 291-312.

Levin, H., & Biemiller, A. J. Studies of oral reading III: Contingent versus non-contingent spelling patterns. In H. Levin, E. J. Gibson, & J. J. Gibson (Eds.), The analysis of reading skill: A program of basic and applied research. Washington: U. S. Department of Health, Education, and Welfare, 1968.

Lieberman, A. M., Cooper, F. S., Shankweiler, D. P., & Studdert-Kennedy, M. Perception of the speech code. Psychological Review, 1967, 74, 431-461.

Marchbanks, G., & Levin, H. Cues by which children recognize words. Journal of Educational Psychology, 1965, 56, 57-61.

Mayzner, M. S., & Tresselt, M. E. The ranking of letter pairs and single letters to match digram and single-letter frequency counts. Journal of Verbal Learning and Verbal Behavior, 1963, 1, 203-207.

Mayzner, M. S., & Tresselt, M. E. Tables of single-letter and digram frequency counts for various word-length and letter-position combinations. Psychonomic Monograph Supplements, 1965, 1, 13-32. (a)

Mayzner, M. W., & Tresselt, M. E. Tables of trigram frequency counts for various word-length and letter-position combinations. Psychonomic Monograph Supplements, 1963, 1, 33-50. (b)

Miller, G. A. Free recall of redundant strings of letters. Journal of Experimental Psychology, 1958, 56, 484-491.

Miller, G. A. The magical number seven, plus or minus two: Some limits on our capacity for processing information. Psychological Review, 1956, 63, 81-97.

Miller, G. A., Bruner, J. S., & Postman, L. Familiarity of letter sequences and tachistoscopic identification. Journal of General Psychology, 1954, 50, 129-139.

Moore, J. T. Phonic elements appearing in a three-thousand-word spelling vocabulary. Unpublished doctoral dissertation, Stanford University, 1951.

Morrison, I. E., & Perry, I. F. Spelling and reading relationships with incidence of retardation and acceleration. Journal of Educational Research, 1959, 52, 222-227.

Neisser, U., & Beller, H. K. Searching through word lists. British Journal of Psychology, 1965, 56, 349-358.

Neisser, U., & Stoper, A. Redirecting the search process. British Journal of Psychology, 1965, 56, 359-368.

Newman, E. B. Speed of reading when the span of letters is restricted. American Journal of Psychology, 1966, 79, 272-278.

Newton, B. M. A study of certain factors related to achievement in spelling. Unpublished doctoral dissertation, University of Missouri, 1960.

Nisbet, J. Graded Word Spelling Test. In O. Buros (Ed.), The fifth mental measurements yearbook. Highland Park (N.J.): Gryphon Press, 1959. p. 370.

Nodine, C. F., & Evans, J. D. Eye movements of pre-readers to pseudowords containing letters of high and low confusability. Perception and Psychophysics, 1961, 6, 39-41.

Pierce, J. R., & Karlin, J. E. Reading rates and the information rate of a human channel. Bell Systems Technical Journal, 1957, 36, 497-516.

Postman, L., & Conger, B. Verbal habits and the visual recognition of words. Science, 1954, 119, 671-673.

Postman, L., & Rosenzweig, M. R. Perceptual recognition of words. Journal of Speech and Hearing Disorders, 1957, 22, 245-253.

Powell, M., O'Conner, H., & Deutsch, M. Are there really sex differences in achievement? Journal of Educational Research, 1963, 57, 210-212.

Reid, J. T. A survey of the language achievement of Alberta school children in relation to bilingualism, sex, and intelligence. Unpublished masters thesis, University of Alberta, 1954.

Reimer, E., & Illich, I. Proposal for a planning seminar aimed at the development of basic educational alternatives. In D. U. Levine, & R. J. Havighurst (Eds.), Farewell to Schools, Belmont: Wadsworth, 1971.

Robertson, J. E. An investigation of pupil understanding of connectives in reading. Unpublished doctoral dissertation, University of Alberta, 1966.

Robinson, C. H. A study of the written language errors of 1238 pupils of Ukrainian origin. Unpublished doctoral dissertation, University of Alberta, 1934.

Rosinski, R. R., & Wheeler, K. E. Children's use of orthographic structure in word discrimination. Psychonomic Science, 1972, 26, 97-98.

Samuels, F. Sex differences in reading achievement. Journal of Educational Research, 1943, 36, 594-605.

Samuels, S. J. Modes of word recognition. In H. Singer & R. B. Ruddell (Eds.), Theoretical Models and Processes of Reading, Newark: International Reading Association, 1970.

Sheldon, W. D., Nichols, N. J., & Lashinger, D. R. Effect of first grade instruction using basal readers, modified linguistic materials and linguistic readers - extended into second grade. Reading Teacher, 1967, 20, 750-725.

Smith, D. F. Yes, American schools are feminized. Phi Delta Kappan, 1973, 54, 703-704

Smith, F. The use of featural dependencies across letters in the visual identification of words. Journal of Verbal Learning and Verbal Behavior, 1969, 8, 215-218.

Smith, F. Understanding reading. Toronto: Holt, Rinehart, & Winston, 1971.

Smith, F. Psycholinguistics and reading. New York: Holt, Rinehart, & Winston, 1973.

Smith, F., & Holmes, D. L. The independence of letter, word, and meaning identification in reading. Reading Research Quarterly, 1971, 6, 394-415.

Spache, G. Spelling disability correlates I - Factors probably causal in spelling disability. Journal of Educational Research, 1941, 34, 561-586.

Stein, J. (Ed.) The Random House dictionary of the English language. New York: Random House, 1966.

Stroud, J. B., & Linquist, E. F. Sex differences in achievement in the elementary and secondary schools. Journal of Educational Psychology, 1942, 33, 657-667.

Thorndike, E. L., & Lorge, I. The teacher's word book of 30,000 words. New York: Teacher's College, Columbia University, 1944.

Townsend, A. An investigation of certain relationships of spelling with reading and academic aptitude. Journal of Educational Research, 1947, 40, 465-471.

Traxler, A. E., & Spaulding, G. Sex differences in achievement of independent school pupils as measured by Stanford Achievement Test, Form K. Education Record Bulletin, 1954, 63, 69-80.

Venezky, R. L. English orthography: Its graphical structure and its relation to sound. Reading Research Quarterly, 1967, 2 75-107. (a)

Venezky, R. L. Reading: Grapheme-phoneme relationship. Education, 1967, 87, 519-524. (b)

Wallach, M. A. Perceptual recognition of approximations to English in relation to spelling achievement. Journal of Educational Psychology, 1963, 54, 57-62.

Wallin, E. Spelling: Factorial and experimental studies. Goteborg (Sweden): Elanders Boktrycken Aktiebolg,

Williams, J., & Levin, H., Word perception; Psychological bases. Education, 1967, 87, 515-518.

APPENDICES

APPENDIX A

SLOSSON ORAL READING TEST

"Keep a record from year to year"

SLOSSON ORAL READING TEST (SORT)

READING LEVEL ____

SCHOOL GRADE ____

NAME ____________________ AGE ______ DATE ____________
LAST FIRST MIDDLE

SCHOOL ____________________

EXAMINER ____________________

List P (20)

1. see
2. look
3. mother
4. little
5. here
6. can
7. want
8. come
9. one
10. baby
11. three
12. run
13. jump
14. down
15. is
16. up
17. make
18. ball
19. help
20. play

____

List 1 (40)

1. with
2. friends
3. came
4. horse
5. ride
6. under
7. was
8. what
9. bump
10. live
11. very
12. puppy
13. dark
14. first
15. wish
16. basket
17. food
18. road
19. hill
20. along

____

List 2 (60)

1. game
2. hide
3. grass
4. across
5. around
6. breakfast
7. field
8. large
9. better
10. suddenly
11. happen
12. farmer
13. river
14. lunch
15. sheep
16. hope
17. forest
18. stars
19. heavy
20. station

____

List 3 (80)

1. safe
2. against
3. smash
4. reward
5. evening
6. stream
7. empty
8. stone
9. grove
10. desire
11. ocean
12. bench
13. damp
14. timid
15. perform
16. destroy
17. delicious
18. hunger
19. excuse
20. understood

____

List 4 (100)

1. harness
2. price
3. flakes
4. silence
5. develop
6. promptly
7. serious
8. courage
9. forehead
10. distant
11. anger
12. vacant
13. appearance
14. speechless
15. region
16. slumber
17. future
18. claimed
19. common
20. dainty

____

List 5 (120)

1. cushion
2. generally
3. extended
4. custom
5. tailor
6. haze
7. gracious
8. dignity
9. terrace
10. applause
11. jungle
12. fragrant
13. interfere
14. marriage
15. profitable
16. define
17. obedient
18. ambition
19. presence
20. merchant

____

List 6 (140)

1. installed
2. importance
3. medicine
4. rebellion
5. infected
6. responsible
7. liquid
8. tremendous
9. customary
10. malicious
11. spectacular
12. inventory
13. yearning
14. imaginary
15. consequently
16. excellence
17. dungeon
18. detained
19. abundant
20. compliments

____

List 7 (160)

1. administer
2. tremor
3. environment
4. counterfeit
5. crisis
6. industrious
7. approximate
8. society
9. architecture
10. malignant
11. pensive
12. standardize
13. exhausted
14. reminiscence
15. intricate
16. contemporary
17. attentively
18. compassionate
19. complexion
20. continuously

____

List 8 (180)

1. prairies
2. evident
3. nucleus
4. antique
5. twilight
6. memorandum
7. whimsical
8. proportional
9. intangible
10. formulated
11. articulate
12. deprecate
13. remarkably
14. contrasting
15. irrelevance
16. supplement
17. inducement
18. nonchalant
19. exuberant
20. grotesque

____

High School (200)

1. traverse
2. affable
3. compressible
4. excruciating
5. pandemonium
6. scrupulous
7. primordial
8. chastisement
9. sojourn
10. panorama
11. facsimile
12. auspicious
13. contraband
14. envisage
15. futility
16. enamoured
17. gustatory
18. decipher
19. inadequacy
20. simultaneous

____

SCORE

List P ____
List 1 ____
List 2 ____
List 3 ____
List 4 ____
List 5 ____
List 6 ____
List 7 ____
List 8 ____
List H. S. ____

Raw Score ____

(Total number of correct words including the words below starting level.)

(Any specific coaching on these particular words will naturally reduce the validity of this test.)

Takes about 3 minutes to give and to score.

SLOSSON ORAL READING TEST (SORT)

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Keep this test in safe drawer or file.

This Oral Reading Test is to be given individually and is based on the ability to pronounce words at different levels of difficulty. The words have been taken from standardized school readers and the Reading Level obtained from testing represents median or standardized school achievement. A correlation of .96 (variability on a group of 108 children from first grade thru high school: Gray Mean = 5.0, SORT Mean = 5.0, Gray S.D. = 2.0, SORT S.D. = 2.3) was obtained with the Standardized Oral Reading Paragraphs by William S. Gray, published by The Bobbs-Merril Company, Inc., Indianapolis, Indiana. Permission to use this test by Gray for purposes of validation is deeply appreciated.

A reliability coefficient of .99 (test-retest interval of one week) shows that this Oral Reading Test can be used at frequent intervals to measure a child's progress in reading, providing no specific coaching with these particular words has been given. Such periodic testing can be highly motivating.

DIRECTIONS

1. Allow the child to read from one sheet while you keep score on another. At the start, say the following: *"I want to see how many of these words you can read. Please begin here and read each word aloud as carefully as you can."* (Indicate at what list to start.) *"When you come to a difficult word, do the best you can and if you can't read it, say 'blank' and go on to the next one."*

2. Start a child with a list where you think he can pronounce all 20 words in that one list correctly. Note that each list of words is graded. List P (primer) is for the first few months of first grade, List 1 is for the balance of first grade, List 2 is for second grade, etc. If the starting list is too difficult and the child makes even one mistake, go back until you reach an easier list where he can pronounce all 20 words correctly.

3. After you have found the starting list, go on into more advanced lists until you find the stopping list, where he mispronounces or is unable to read all 20 words. When you reach a point where the words become very difficult, say: *"Look quickly down this list and read the words you think you know."*

4. When a child reads very slowly and takes more than 5 seconds on each and every word, move him along by saying the "blank" for him. Or call out the number of the word at a rate of about 5 seconds each. Still another plan is to use a small card or piece of paper, covering up a word after a 5 second exposure, forcing him on to the next word.

5. Count as an error each mispronounced or omitted word as well as a word which takes more than about 5 seconds to pronounce. (If a child has a speech defect such as a stutter, disregard the 5 second interval and allow as much time as necessary.) Count it an error when a child is uncertain about a word and gives more than one pronunciation, even though one of them may have been correct. Be particularly careful about scoring the word endings as they must be absolutely correct. Keep score by putting a check mark (✓) after each error or a plus sign (+) after each correct word. Enter the number of correct words at the bottom of each list as you go along. An analysis of scatter on the test, as well as an analysis of the types of errors made, will indicate areas of weakness.

6. To find a child's raw score for reading, count the total number of words he was able to pronounce correctly in all lists and add the words below the starting list for which he automatically receives credit. To obtain the Reading Level, look up the value of this raw score in Table 1 below. A simple way to determine the Reading Level is to take half the raw score. For example, if the raw score were 46, half of this number would be 23 and the Reading Level would be 2.3 or the 3rd month of 2nd grade.

TABLE I

CHANGING THE RAW SCORE TO READING LEVEL

(Reading Grade Level is given in years and months. For example, 5.2 means the 2nd month of 5th grade.)

SCORE	GRADE	SCORE	GRADE	SCORE	GRADE	SCORE	GRADE	SCORE	GRADE	SCORE	GRADE	SCORE	GRADE
0-1	0.0	26-27	1.3	52-53	2.6	78-79	3.9	104-105	5.2	130-131	6.5	156-157	7.8
2-3	0.1	28-29	1.4	54-55	2.7	80-81	4.0	106-107	5.3	132-133	6.6	158-159	7.9
4-5	0.2	30-31	1.5	56-57	2.8	82-83	4.1	108-109	5.4	134-135	6.7	160-161	8.0
6-7	0.3	32-33	1.6	58-59	2.9	84-85	4.2	110-111	5.5	136-137	6.8	162-163	8.1
8-9	0.4	34-35	1.7	60-61	3.0	86-87	4.3	112-113	5.6	138-139	6.9	164-165	8.2
10-11	0.5	36-37	1.8	62-63	3.1	88-89	4.4	114-115	5.7	140-141	7.0	166-167	8.3
12-13	0.6	38-39	1.9	64-65	3.2	90-91	4.5	116-117	5.8	142-143	7.1	168-169	8.4
14-15	0.7	40-41	2.0	66-67	3.3	92-93	4.6	118-119	5.9	144-145	7.2	170-171	8.5
16-17	0.8	42-43	2.1	68-69	3.4	94-95	4.7	120-121	6.0	146-147	7.3	172-173	8.6
18-19	0.9	44-45	2.2	70-71	3.5	96-97	4.8	122-123	6.1	148-149	7.4	174-175	8.7
20-21	1.0	46-47	2.3	72-73	3.6	98-99	4.9	124-125	6.2	150-151	7.5	176-177	8.8
22-23	1.1	48-49	2.4	74-75	3.7	100-101	5.0	126-127	6.3	152-153	7.6	178-179	8.9
24-25	1.2	50-51	2.5	76-77	3.8	102-103	5.1	128-129	6.4	154-155	7.7	180-200	H.S.

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APPENDIX B

GRADED WORD SPELLING TEST B

(SCHONELL)

Graded Word Spelling Test B

by

Fred J. Schonell, M.A., Ph.D., D.Lit.

Instructions and details of interpretation of this test are to be found in
DIAGNOSTIC AND ATTAINMENT TESTING
and in
READING AND SPELLING TESTS: HANDBOOK OF INSTRUCTIONS

Oliver and Boyd Ltd., Tweeddale Court, Edinburgh 1

see	cut	mat	in	ran
bag	ten	hat	dad	bed
leg	dot	pen	yet	hay
good	till	be	with	from
time	call	help	week	pie
boat	mind	sooner	year	dream
sight	mouth	large	might	brought
mistake	pair	while	skate	stayed
yoke	island	nerve	join	fare
iron	health	direct	calm	headache
final	circus	increase	slippery	lodge
style	bargain	copies	guest	policy
view	library	cushion	safety	patient
account	earliest	institution	similar	generous
orchestra	equally	individual	merely	enthusiastic
appreciate	familiar	source	immediate	breathe
permanent	sufficient	broach	customary	especially
materially	cemetery	leisure	accredited	fraternally
subterranean	apparatus	portmanteau	politician	miscellaneous
mortgage	equipped	exaggerate	amateur	committee

APPENDIX C

TEST OF ORTHOGRAPHIC STRUCTURE

NAME ______________ GRADE ____________________

1.	scup	spcu	sace
2.	drdy	dreb	dray
3.	strop	scibe	scitb
4.	yaws	yatw	yort
5.	huzz	hzuf	heft
6.	smruth	smutch	starsh
7.	stace	scurf	sruct
8.	rin	ret	rlt
9.	surdq	squit	shard
10.	senpw	spere	swain
11.	stong	snogt	snath
12.	bleb	bnel	brin
13.	gcot	grog	geft
14.	wbilr	wribs	whorl
15.	shunt	snasp	snhun

APPENDIX D

TEST OF LETTER FAMILIARITY

NAME ____________________ GRADE ____________________

1. g_ig (k l r)
2. pri_k (s g n)
3. ki_h (c t b)
4. yaw_ (l r k)
5. tin_ (g p k)
6. s_reed (l c t)
7. we_t (f c j)
8. _uern (v r q)
9. knu_l (t r l)
10. s_og (l w g)
11. qui_ch (t n s)
12. t_ill (w m h)
13. _litch (h f g)
14. _lebs (p s j)
15. bran_ (h s t)

16. scri_ (q p n)

17. _hrips (d t c)

18. lar_h (k t c)

19. _hews (t d w)

20. b_act (l r n)

APPENDIX E

TEACHER QUESTIONNAIRE

Name:

Time spent per day on reading:

Please list the materials (texts, workbooks, etc.) that you use in the teaching of:

1. reading -

2. phonics -

3. language (grammar) -

4. creative writing:

5. spelling:

6. any other area of language arts -